Irrigation Water Efficiency in the Canale Emiliano Romagnolo District, Italy. An assessment of the existing water governance system and prospects for change

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Irrigation water efficiency in the Canale Emiliano Romagnolo district, Italy

An assessment of the existing water governance system and prospects for change

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This study takes place within the SIRRIMED WP6 - Irrigation Water Economics and Governance. The aim of WP6 is to evaluate the economic impacts of existing and new water saving approaches in irrigated agriculture and (re)design governance approaches to promote sustainable water use. Together with similar studies that will be conducted in other SIRRIMED case study areas this study constitutes the basis for a cross-case comparison aiming to assess the transferability of best practices across regions and to identify common critical factors for improving irrigation water efficiency.

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Executive summary

This research has two objectives: 1) to assess the existing water governance system in terms of its capacity to support irrigation water efficiency in the Consorzio di Bonifica per il Canale Emiliano Romagnolo (land reclamation consortium for the Canale Emiliano Romagnolo) district in the Emilia Romagna region, Italy; 2) to identify context relevant institutional dynamics that could enable greater irrigation water efficiency. To this end, an analysis of key dimensions of the irrigation water governance system is conducted following the Policy Arrangement Approach (Arts *et al*. 2006).

Emilia-Romagna is one of the richest regions of Italy and among the regions with the highest levels of product per capita in Europe. Agriculture plays an important role in the context of regional production. Agricultural land covers 60% of the entire regional territory. About 33% of the regional farms include irrigated land. The most used irrigation system in the region is sprinkler (59% of the total irrigated area) followed by micro-irrigation (24%), furrow and border irrigation (12%), and submersion irrigation (3%) (ISTAT 2010). However, the picture is different when considering the most important cash crops: fruit trees are mainly drip irrigated (up to 90% in many areas); vegetable for processing or fresh market (i.e. processing tomato, potato, snap beans, onion, lettuce, etc.) are micro-irrigated when cropped on land owned by the farmer and sprinkler irrigated elsewhere.

Fresh water is relatively abundant in the Emilia-Romagna region although changes in the geographical distribution of rainfall (ARPA 2010) have caused significant water deficit in some areas and episodes of water shortage are expected to increase in the future. Water is more abundant in the north-west side of the region (called Emilia), whereas in the south-east side (called Romagna) surface water has always been limited. This situation has been partly compensated by the construction (started in 1955) of an artificial canal conveying irrigation water called Canale Emiliano Romagnolo (CER).

The CER is an artificial water systems made up of a main canal designed to be 150 km long (still 15 km to be built) and a number of lower order canal delivering water mostly for irrigation purposes to a territory spanning over 3000 km^2 in the Emilia-Romagna plain. The planning, construction and management of the CER canal is responsibility of the Second-order Land Reclamation Consortium for the Canale Emiliano Romagnolo (CER Consortium). Since 1959 the CER Consortium has also been in charge of research on irrigation and providing technical assistance and training to farmers for the efficient use of irrigation water.

Below key findings for each dimension of the Policy Arrangement Approach are reported. A policy arrangement refers to the way in which a specific policy domain is shaped in terms of organization (actors, rules and resources) and substance (discourses) in a bounded time-space context (Arts and Tatenhove 2004, 341).

Actors

- Water governance in Italy and in Emilia-Romagna is fragmented, with a number of agencies at different scales in charge of water management, i.e. water boards, regional departments, provinces, land reclamation consortia.
- Irrigation water management is clearly organized, and “who does what” is unambiguous and transparent.

- Despite differences in views and interests, public officers are committed to cooperative planning and policy-making. But conflicts do arise at the level of the political leadership.
- Two coalitions are identified in this report: agriculture and environment. These coalitions tend to clash in times of water scarcity. In these situations the conflict of interest between agricultural production and environmental protection erupts. The CER consortium tends to play the role of the mediator between the opposing coalitions.

Resources

- The CER consortium is the regional reference for research on irrigation efficiency; it organizes training programs for farmers and information campaigns on efficient irrigation and water saving measures.
- Scientific knowledge on irrigation efficiency is well developed in the CER district. However, there is still room for improvement, particularly in the areas not reached by the CER consortium services.
- The regional agriculture department has invested many financial resources on irrigation and water saving research, training and information campaigns. However, resources are increasingly less available due to the current economic crisis.
- There are major territorial differences in Emilia-Romagna and in the CER district with regard to water delivery systems and pricing. The most efficient delivery system is through pressured pipes. Although expanding especially in the CER district, this is not yet a wide-spread water distribution system. The most used delivery system is through a network of uncoated canals from which farmers can withdraw water according to the license they have received (typically they are allowed to withdraw water on scheduled days and hours). As for the contribution, this is made up of two parts: there is a fixed share per hectare and a variable share accounting for the volume of water used. The measurement of quantity of water used is not precise in most cases where a meter is missing; in cases where there is a meter, measurement is precise.
- The water distribution infrastructure is currently not optimized from the perspective of irrigation water efficiency. Micro-irrigation is not compatible with water distribution schemes organized on shifts (meaning that farmers do not have access whenever they want but only on scheduled days and hours) which is common where there is not sufficiently wide water network or lack of water availability. Water loss during distribution is up to 41% due to the aging infrastructure and leakage from uncoated canals.
- There is limited capacity at the local level to invest in new infrastructure. Major investments are needed by the land reclamation consortia on the irrigation and drainage network. However, the contribution paid by the consortia members barely covers ordinary maintenance costs and planning extraordinary works or additional infrastructure is hardly possible.

Rules

- Each regional government has its own water strategy, objectives and management structure and acts individually in the various water policy arenas. Because of this regional approach coupled with insufficient inter-regional coordination on water management issues the capacity of the national bureaucracies to represent the

interest of the country in international water policy and political contexts is limited which in turns often lead to Italy being subjected to European decisions.

- The large amount of rules and red tape associated with water management make it difficult to invest in new irrigation water infrastructure, including water reservoirs.
- The recent reform of the election system for boards of the land reclamation consortia moves in the direction of a more balanced representation of water users' interests in the consortia board. However, additional reforms will be needed in the future to reflect the increasing diversification of uses of water supplied by the consortia.
- A number of procedures are in place for addressing water crises, including the establishment of the so called "cabina di regia" at political level and a number of thematic discussion groups at policy-making level. These coordinating institutions bypass the fragmentation of responsibility and respondents think it would be useful they were established on a permanent basis.

Discourses

- The concept of irrigation water efficiency is framed differently depending whether it is considered from an agricultural perspective or an environmental perspective. According to the agriculture perspective water efficiency has to be seen in terms of water used versus agriculture output. In this view increasing water efficiency and productivity is important because it implies less production costs (i.e. less water and energy costs), which is vital for maintaining the competitiveness of the irrigated agriculture sector on the global market. Because the total amount of water is limited and all uses need to be ensured, the environmental perspective focuses on the water balance (i.e. withdrawals versus water used). From this point of view water saving is important and takes the form of reduction of losses and reduction of consumption/use.
- Irrigation water pricing is subject of major debate. There are substantial regional differences on water pricing systems. In general, the perception of respondents is that the current irrigation water price is barely sustainable for both farmers and consortia. Some respondents support the idea that water price should be differentiated according to uses and specifically that irrigation water should have a lower price than water used for other purposes. Extreme positions also emerged on this matter, being some respondent convinced that current water price is too low and some others that it is too high.

Findings suggest that major differences exist with regard to irrigation water efficiency at regional level. A closer look to the CER irrigation district reveals that in this territory irrigation water efficiency has been increasing over the years although there is room for further improvements. The main reason for this performance is the need to overcome water shortage. Under the pressure of water scarcity, especially in the Romagna part of the region, an artificial irrigation water canal, the CER canal, was constructed in the second half of the twentieth century. This large infrastructure stimulated a number of further actions including the construction of a network of canals and related infrastructure for water distribution as well as research on how to efficiently use the CER canal water. These actions favoured the development of connections, relations of trust and cooperation among stakeholders. Over 50 years later the outcome of this process is today's high level of social capital, knowledge and expertise in the irrigation water domain which is the major strengths of the existing irrigation water governance system. The CER consortium is a crucial organization in

this system linking national, regional and local policy-makers to farmers and their representatives and with capacity to connect to international organizations as well.

Much can still be done both at the farm level and at the water network level to improve irrigation water efficiency in the CER district, however. At the farm level, more training on how to properly use irrigation technology and information on the importance of using water efficiently is needed as the main driver for switching to more efficient technology is still economic. About the water distribution network, the main problem is lack of long-term investment planning and difficulty to generate sufficient resources. Finally, the fact that irrigation water management is nested in a fragmented water governance system is a major limitation to further improving irrigation water efficiency. Although, reforming the water governance system is responsibility of the national government, greater coordination of regions would help guiding this reform as well as having a stronger voice in international water policy arenas.

To conclude, although there is still room for improvement the existing irrigation water governance system in the CER district could be taken as example of a governance system where there is capacity building to improve irrigation water efficiency and to adjust to changing circumstances. This conclusion has to be taken with the understanding that building factors of success such as social capital, credibility and trust takes time, as well as the investment of financial resources.

Sintesi del rapporto

Il presente rapporto si propone due obiettivi: 1) analizzare l'attuale sistema di *governance* dell'acqua a uso irriguo nel distretto del Consorzio di Bonifica per il Canale Emiliano Romagnolo in Emilia Romagna (Italia), 2) individuare le dinamiche istituzionali che potrebbero portare a promuovere una maggiore efficienza dell'irrigazione. A tal fine, è stata condotta un'analisi delle dimensioni chiave della *governance* dell'acqua a uso irriguo (attori, regole, risorse e discorsi) secondo il quadro analitico del Policy Arrangement Approach (Arts *et al*. 2006).

L'Emilia-Romagna è una delle regioni più ricche d'Italia e tra le regioni con i più alti livelli di prodotto pro-capite in Europa. L'agricoltura svolge un ruolo importante nell'ambito della produzione regionale. L'agricoltura è praticata nel 60% del territorio regionale e circa il 33% delle aziende irriga una parte dei propri terreni. Il sistema d'irrigazione più utilizzato nella regione è quello a spruzzo (59% della superficie irrigata totale), seguito da micro-irrigazione (24%), scorrimento (12%), e immersione (3%). Tale rappresentazione cambia se si guarda alle coltivazioni più redditizie: i frutteti sono prevalentemente irrigati con micro-irrigazione (in alcuni territori fino al 90% delle produzioni); orticole per il consumo fresco e per la trasformazione (es. pomodoro da trasformazione, patate, cipolle, lattuga, etc.) sono micro-irrigate quando coltivate su terreni in proprietà e irrigate a spruzzo nei terreni in affitto.

L'Emilia-Romagna è una regione relativamente ricca di acqua dolce. Tuttavia nel corso degli ultimi anni in alcune zone gli episodi di deficit idrico sono aumentati significativamente e le previsioni indicano un'intensificazione di tali fenomeni. L'acqua è più abbondante nella parte nord-ovest della regione (Emilia), mentre nell'area sud-est (Romagna) le acque superficiali sono sempre state scarse. Questa situazione è stata in parte compensata dalla costruzione (iniziata nel 1955) del Canale Emiliano Romagnolo (CER).

Il CER è un sistema idrico artificiale costituito da un canale principale che a completamento raggiungerà i 150 km di lunghezza e una serie di canali secondari per il trasporto di acqua a prevalente uso irriguo in un territorio vasto più di 3.000 km^2 in Emilia-Romagna. La progettazione, realizzazione e gestione del CER è di competenza del Consorzio di Bonifica di Secondo Grado per il Canale Emiliano Romagnolo (Consorzio CER). Dal 1959 il Consorzio CER si occupa anche di effettuare ricerche su irrigazione e di fornire assistenza tecnica e formazione agli agricoltori per l'uso efficiente dell'acqua di irrigazione.

Di seguito si riportano i principali risultati dell'analisi per ciascuna delle dimensioni del Policy Arrangement Approach.

Attori

- La governance delle risorse idriche in Italia e in Emilia-Romagna è frammentata, con un certo numero di organi di governo responsabili della gestione tra cui le autorità di bacino, diversi assessorati regionali, province, consorzi di bonifica.
- L'organizzazione della gestione dell'acqua ad uso irriguo ("chi fa che cosa") è chiara e trasparente.
- Nonostante le differenze di opinioni e interessi, gli organi esecutivi-tecnici delle pubbliche amministrazioni sono impegnati nella collaborazione per la pianificazione delle risorse idriche. I conflitti, quando sorgono, sono di natura politica e coinvolgono gli organi politici delle amministrazioni.

- Lo studio ha identificato due coalizioni portatrici di interessi diversi: la coalizione dei portatori degli interessi del mondo agricolo e la coalizione dei portatori di interessi ambientali. Queste coalizioni tendono a emergere in situazioni di scarsità della risorsa idrica quando il conflitto di interessi tra la produzione agricola e la protezione dell'ambiente diventa evidente. Il consorzio CER svolge spesso il ruolo di mediatore tra le opposte coalizioni.

Risorse

- Il consorzio CER è il referente regionale per la ricerca scientifica in materia di efficienza irrigua; il consorzio organizza programmi di formazione per gli agricoltori e campagne di informazione sull'irrigazione efficiente e le misure di risparmio idrico.
- La conoscenza scientifica in materia di efficienza dell'irrigazione è ben sviluppata nel distretto irriguo del CER. Tuttavia, c'è ancora molto da fare, in particolare nelle zone non raggiunte dai servizi del consorzio CER.
- L'assessorato regionale per l'agricoltura ha investito negli anni importanti risorse finanziarie per la ricerca scientifica sull'efficienza irrigua, per la formazione degli agricoltori e la divulgazione sui temi del risparmio e dell'efficienza irrigua. Tuttavia, la crisi economica in atto è fonte di forti riduzioni degli investimenti in questo settore.
- Ci sono grandi differenze territoriali all'interno del distretto CER e in generale in tutta regione Emilia-Romagna sui sistemi di distribuzione dell'acqua irrigua e sui sistemi di calcolo del costo della stessa. Il sistema di distribuzione più efficiente è quello di consegna dell'acqua attraverso tubi in pressione. Questo sistema però non trova ancora ampia diffusione a causa di limiti strutturali dei sistemi di distribuzione e mancanza di risorse per effettuare gli investimenti da parte dei consorzi. Il sistema di distribuzione ad oggi più usato è attraverso una rete di canali non rivestiti da cui gli agricoltori possono prelevare l'acqua secondo la concessione che hanno ottenuto, in genere per alcune ore nei giorni stabiliti secondo un sistema di turnazione. Per quanto riguarda il contributo consortile per il recupero dei costi di distribuzione (quella che impropriamente viene chiamata tariffa), essa è di tipo cosiddetto "binomio": l'agricoltore paga una quota fissa per ettaro e una quota variabile per il volume di acqua utilizzata. La quota fissa in alcuni casi può variare con il tipo di coltura prodotta se questo dato è disponibile. Il calcolo del volume di acqua utilizzata è preciso quando è presente un contatore (pratica non ancora largamente diffusa), è invece meno preciso nella maggior parte dei casi in cui il contatore non è installato.
- La rete infrastrutturale di distribuzione dell'acqua irrigua non è ottimizzata per garantire la massima efficienza irrigua. In molte zone, infatti, la rete non è sufficiente a garantire l'acqua con continuità, o non vi è acqua a sufficienza e la distribuzione avviene su turnazione. Questo impedisce agli agricoltori serviti con questa modalità distributiva di poter installare impianti di micro-irrigazione (ad alta efficienza) per i quali è richiesto un apporto continuativo di acqua. Inoltre, la perdita d'acqua durante la distribuzione arriva fino al 41% a causa della obsolescenza delle infrastrutture e l'infiltrazione nei canali non rivestiti.
- La capacità a livello locale di investire in nuove infrastrutture di distribuzione idrica è limitata. Investimenti ingenti da parte dei consorzi di bonifica sono necessari su gran parte della rete di drenaggio e distribuzione dell'acqua. Tuttavia, il contributo versato dai consorziati copre a malapena i costi di manutenzione ordinaria e la

pianificazione di lavori straordinari o di nuove infrastrutture è pressoché impossibile.

Norme per le decisioni

- Ogni regione gestisce la risorsa idrica in modo autonomo, con propria strategia, obiettivi, norme e organismi di gestione. Ogni regione porta avanti la propria politica di gestione dell'acqua in modo autonomo nelle sedi nazionali e internazionali. Il coordinamento inter-regionale è insufficiente. Questo rende difficile la gestione di bacini idrici inter-regionali ed è motivo di poca capacità di rappresentare gli interessi dell'Italia nei contesti europei dove vengono assunte le decisioni per la gestione delle risorse idriche.
- L'eccesso di burocrazia tipicamente italiano che si riscontra in modo forte nelle opere pubbliche rende difficile investire in infrastrutture per garantire la sicurezza della risorsa irrigua, come ad esempio la costruzione di invasi di raccolta dell'acqua.
- La recente riforma del sistema elettorale dei consigli di amministrazione dei consorzi di bonifica va nella direzione di una rappresentazione più equilibrata degli interessi dei diversi utilizzatori della risorsa idrica distribuita dai consorzi. Tuttavia, ulteriori riforme saranno necessarie in futuro per riflettere la crescente diversificazione degli usi dell'acqua fornita dai consorzi.
- Un certo numero di procedure sono in atto per affrontare le situazioni di siccità. In particolare il ricorso alla cosiddetta "cabina di regia" a livello politico permette di affrontare le emergenze. Inoltre, un certo numero di tavoli tematici a livello tecnico per la discussione di problematiche specifiche di allocazione delle risorse idriche è attivo a livello regionale. Queste istituzioni di coordinamento permettono di superare la frammentazione delle responsabilità nelle situazioni di emergenza.

Discorsi che ruotano intorno al tema dell'efficienza irrigua

- L'efficienza irrigua è percepita in modo diverso dai portatori di interessi del mondo agricolo rispetto ai portatori di interessi di tutela dell'ambiente. Secondo la prospettiva del mondo agricolo l'efficienza idrica in agricoltura deve essere vista in termini di acqua utilizzata rispetto alla produzione. Per gli agricoltori aumentare l'efficienza dell'irrigazione significa aumentare l'efficienza della produzione, elemento fondamentale per garantire la competitività dell'agricoltura regionale sui mercati internazionali. Dal punto di vista degli ambientalisti invece è la quantità totale di acqua che va preservata in quanto limitata e tutti gli usi devono essere garantiti. In quest'ottica il focus è sul bilancio idrico e sulla necessità di ridurre le perdite e gli usi per garantire una maggiore quantità totale di acqua.
- Il contributo consortile pagato dagli agricoltori è oggetto di grande discussione. Ci sono notevoli differenze regionali in materia di sistemi di calcolo del contributo consortile. In generale, la percezione degli intervistati è che l'attuale prezzo pagato dagli agricoltori sia a malapena sostenibile sia per gli agricoltori sia per i consorzi di bonifica. Alcuni sostengono che il prezzo dell'acqua debba essere differenziato a seconda degli usi e che l'acqua irrigua debba avere un prezzo inferiore a quella destinata ad altri usi. Altri sostengono che l'attuale prezzo pagato sia eccessivo; altri ancora che sia troppo basso.

L'analisi rivela l'esistenza di differenze sostanziali a livello regionale dell'efficienza dell'irrigazione. Spostando il focus sul distretto CER si vede come in questo territorio l'efficienza irrigua sia in continua crescita, sebbene vi sia ancora un importante margine di miglioramento. La ragione principale di questa performance si trova nella

necessità di superare la mancanza di acqua già manifesta nel secolo scorso. La costruzione di un importante via d'acqua, il canale CER, ha attivato una serie di azioni sia nel campo della realizzazione di infrastrutture distributive che in quello della ricerca scientifica per l'utilizzo efficiente dell'acqua del CER. Queste azioni hanno favorito lo sviluppo di connessioni, la costruzione di relazioni di fiducia e di cooperazione fra le parti interessate. Oltre 50 anni dopo, il risultato di questo processo è un elevato livello di capitale sociale e l'esistenza di solide conoscenze scientifiche e competenze in materia di efficienza irrigua che sono i maggiori punti di forza dell'attuale sistema di governance dell'acqua ad uso irriguo.

Molto può essere ancora fatto comunque sia a livello di aziende agricole che a livello di rete idrica. A livello di azienda agricola, è necessario investire ulteriormente sulla formazione degli agricoltori per il corretto utilizzo della tecnologia irrigua oltre che su campagne di informazione per il risparmio idrico in quanto il principale motivo che spinge gli agricoltori ad adottare tecnologie irrigue efficienti rimane quello economico. Per quanto riguarda la rete di distribuzione idrica, il problema principale è la mancanza di pianificazione degli investimenti di lungo termine e la difficoltà a raccogliere risorse sufficienti per la realizzazione di nuove infrastrutture. Infine, la frammentazione delle responsabilità per la gestione delle risorse idriche in Italia è un limite importante al miglioramento dell'efficienza dell'irrigazione. Un maggiore coordinamento delle regioni aiuterebbe ad indirizzare la necessaria riorganizzazione dell'attuale sistema di norme per la gestione dell'acqua in capo al governo nazionale.

Concludendo, anche se c'è ancora margine di miglioramento dell'efficienza irrigua, in generale, il distretto CER può essere preso come esempio di una realtà dove esistono le capacità, le competenze e il capitale sociale necessario per progredire nel percorso di miglioramento dell'efficienza irrigua e di adattamento ai cambiamenti climatiche e alle mutazioni socio-economiche. La trasferibilità di questo modello è condizionata alla costruzione di fattori di successo quali le competenze, la fiducia, il capitale sociale, la capacità di riformare le norme quando necessario, processi questi che richiedono tempo e investimento di risorse.

1 Introduction

Renewable fresh water resources are finite and unevenly distributed in space and time on Earth. Raising food demand due to population growth, more frequent and severe droughts due to climate change as well as growth and changes in the global economy put increasing pressure on global water resources. Over the last 50 years water withdrawals have tripled mainly under the pressure of food demand (WWDR 2009). The scale of future demands is still uncertain but considered the trend of population growth it is expected to increase significantly. According to recent estimates by 2025 as many as 3 billion people may be living in water-stressed countries (WWDR 2009).

Worldwide, irrigated agriculture, which covers 18% of the arable land, uses 70% of the global fresh water withdrawals to produce 40% of the global food (WWDR 2009; World Bank 2006). The European agricultural sector is on average responsible for 24% of this global water use (EEA 2009). In central and northern Europe irrigated agriculture uses from 0 to 30% of the total European water withdrawals, generally in dry summers to improve production. In contrast, in southern Europe irrigation is an essential element of agricultural production whose absence would create great economic hardship, including potential for land abandonment. It is calculated that irrigation in Mediterranean countries like Italy, Spain, France, Portugal and Greece accounts for up to 80% of the total water use. The trend is generally increasing although the total irrigated land is expected to remain stable (EEA 2009).

The agriculture sector has considerable capacity to improve current irrigation water management practices, especially in terms of water saving potential (EEA 2012). Research has shown that enhancing irrigation efficiency alone may meet one-half of the increase in water demand through 2025 (Seckler *et al*. 1998). To improve irrigation efficiency, the EU has been supporting the adoption of more sustainable irrigation practices through the EU Common Agricultural Policy (CAP) and the Water Framework Directive (WFD). Both structural (e.g. construction of water reservoirs, adoption of efficient irrigation technologies) and non-structural (e.g. legislation and allocation mechanisms) measures are promoted.

Meeting the water needs of the society and the environment is increasingly considered a problem of water governance (EEA 2012; Iza and Stein 2009). Water governance refers to the political, social, economic and administrative systems that directly or indirectly affect the use and management of water resources (Iza and Stein 2009). It is concerned with issues such as equity and efficiency in water resource allocation, balancing water uses and ecosystems needs, integrated water management and management at catchment level. Its focus is on formulation and implementation of water policies, legislation and institutions and on roles and responsibilities of government, civil society and the private sector about ownership, management and administration of water resources and services.

The **objective of this report** is to assess the existing water governance system in terms of its capacity to support irrigation water efficiency in the Canale Emiliano Romagnolo District in the Emilia Romagna region, Italy and identify context relevant institutional dynamics that could enable greater irrigation water efficiency. To this end, an analysis of key dimensions of the water governance system (actors, rules, resources and discourses) is conducted following the Policy Arrangement Approach (Arts *et al*. 2006).

The report is structured as follows. Chapter 2 illustrates the analytical framework, methods and data used to conduct the investigation. A description of the case study

area is laid out in chapter 3. Results of the analysis are organized around four key dimensions and presented in chapter 4. Main observations are highlighted in bullet points at the end of each section. Findings are then summarized in a SWOT matrix in chapter 5. Finally, chapter 6 draws a set of policy recommendations and chapter 7 lays out the conclusions.

2 Methodological approach

2.1 Analytical framework

To describe and analyze the irrigation water governance system in the case study area and later on to compare it with other case studies, this report uses the four analytical dimensions of the policy arrangement approach (PAA). In the following the PAA is briefly described based on the work of its developers (Arts and Tatenhove 2004; Arts *et al*. 2006; Leroy and Arts 2006; Liefferink 2006) and put into the context of this report.

A policy arrangement refers to the way in which a specific policy domain is shaped in terms of organization and substance in a bounded time-space context (Arts and Tatenhove 2004, 341). The characteristics of a policy arrangement can be analyzed along the following four dimensions (the former three referring to the organizational and the last one to the substantial aspects of policy):

- The *actors* and their *coalitions* involved in the policy domain. A policy coalition consists of a number of actors who share resources and/or interpretations of a policy discourse and engage in policy processes to achieve a common policy goal;
- The division of *resources* between these actors leading to differences in power and influence. Resources include money, personnel, facilities, instruments, expertise, knowledge, learning capacity, and communication possibilities;
- The *rules of the game* currently in operation. Rules delineate a policy domain by guiding and constraining the behaviour of individual actors; for instance rules define procedures, division of task and responsibility between actors and organization;
- The current policy *discourses.* The concept of discourse refers to the interpretative scheme (storylines and narratives) that actors use to give meaning to a policy domain. A discourse is a specific ensemble of ideas, concepts and categorizations that is produced by actors underlining principles, objectives, norms and values, perceptions of problems and approaches to solutions.

As analytical concept the PAA aims to understand policy making dynamics as the interplay of the four described dimensions in everyday practices. Any change in one dimension induces changes to other dimensions (the interrelation of the dimensions is represented with a tetrahedron, see Figure 2.1). In addition, the PAA pays attention to stability and change of policy making at different geographical and administrative levels. In this regard, the PAA recognizes that arrangements are under the pressure of constant change either by policy innovation (policy actors decide to do things differently for example because of a changed policy context or a “shock event”) or by macro-processes of social and political change. Furthermore, policy arrangements may evolve at different vertical levels of policy making (local, regional, national, transnational) or interconnect these levels as they are characterized by specific spatial boundaries (administrative as well as bioregional).

The PAA has been applied in earlier studies of environmental policies, nature conservation and water management (Arnouts *et al*. 2011; Wiering and Arts 2006; Wiering and Immink 2006) where it proved useful analytical tool to explain policy making dynamics and opportunities for change.

2.2 The Policy Arrangement Approach in the context of this report

The policy arrangement analyzed in this report is the irrigation water governance system of the Canale Emiliano Romagnolo district in the Emilia Romagna Region, Italy.

The PAA is suitable to study irrigation water governance because it attaches the same importance to the dimensions of actors, resource, rules and discourse. In this report the PAA is applied as both a descriptive and analytical tool. As descriptive tool the PAA is used to make an encompassing and structured description of the specific irrigation water governance system, thus allowing cross-case analysis later on (in a different report). As analytical tool the PAA is used to assess the existing (dis)incentives to irrigation water efficiency and to find context relevant approaches to improve irrigation water efficiency within the specific case study. As Figure 2.1 illustrates the interplay of the four dimensions of the PAA is expected to influence irrigation water efficiency. Water efficiency is here intended as all technological, infrastructural, regulatory and policy measures aiming to reduce irrigation water use in agriculture.

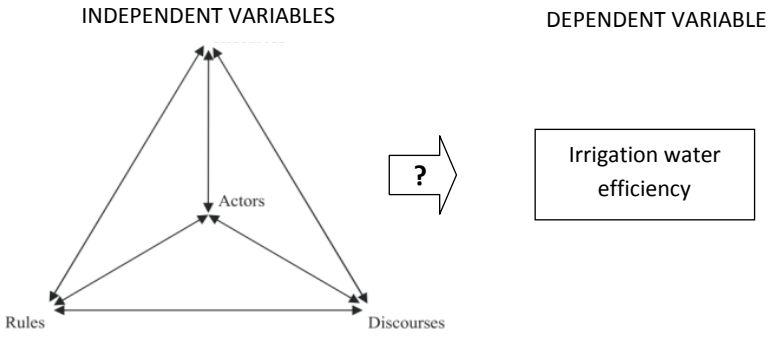


Figure 2.1 Understanding irrigation water efficiency

2.3 Methods and data

The empirical findings presented in this report are based on qualitative analysis of archive data and interviews.

The collected material includes legal and policy documents, and assessment and thematic reports related to the case study and the research subject. These documents provided background information on the irrigation water sector in the case study area, particularly about irrigation technologies adopted, type of agriculture production and organization of the irrigation water system. A number of documents and quantitative data were provided by the Italian SIRRIMED project partner (i.e. the Consorzio di Bonifica di Secondo Grado per il CER). Other documents were downloaded from the website of public agencies such as the Italian Ministry of Agriculture, the Emilia Romagna Region (agriculture department and environment department), ARPA Emilia Romagna (Regional Agency for Environmental Protection), Land Reclamation Consortia of Romagna, Land Reclamation Consortia of Emilia Centrale, INEA (National Institute for Agriculture), URBER (Regional Union of Land Reclamation Consortia of Emilia Romagna), ANBI (National Union of Land Reclamation Consortia), OECD (Organization for Economic Cooperation and Development).

Furthermore, field data were collected through semi-structured in-depth interviews that were held in the Emilia Romagna region in September-October 2012 (see Annex A

and B for the questionnaire and the list of interviewees). First, the dimensions of the PAA were operationalized through a set of 25 questions. Then, the researcher together with the Italian SIRRIMED project partner identified the appropriate informants. The selection was based on informants' knowledge about the irrigation water governance system in the studied area, as well as their working position, their expertise, and their views on the irrigation water governance system. This peer contact resulted in a list of 10 key informants. All of them accepted to be interviewed, and nine out of ten gave consent to publish their name. All interviews were transcribed and analyzed according to the PAA. The results are presented in a way that does not allow to link statements to individuals.

The discussion on possible improvements of the current irrigation water governance system is conducted with the aid a SWOT matrix. Here, the findings of the analysis presented in the report are articulated in internal strengths, weaknesses of the current governance system and external political, economic and policy opportunities and threats for irrigation water efficiency.

3 Study area

3.1 Irrigated agriculture in Emilia-Romagna

Emilia-Romagna is one of the richest regions of Italy and among the regions with the highest levels of product per capita in Europe. The territory is characterized by a high concentration of manufacturing activities, industries (including some important food processing industries), intensive agriculture, and sprawled urbanization.

Agriculture plays an important role in the regional economy being it highly dynamic and integrated in the national and European agricultural context (INEA 2009). The sector is characterized by a chain system that integrates production, processing and distribution and that is strongly linked to the territory and the agricultural base. On the production side there is a predominance of small and medium-sized farms, specialized and oriented to high quality typical products, with a high degree of mechanization. These farms are directly connected to large food processing and distribution industries, which provide adequate market access to the mass agriculture production.

Agricultural land covers 60% of the entire regional territory. This percentage rises to 80% in the plain areas which represent nearly half of the territory. The development of large scale land reclamation and irrigation systems since Roman times have allowed the establishment of intensive agriculture particularly in the plain areas of the region (most of which used to be low lying marshland).

About 33% of the regional farms (a little more than 24.300 in absolute terms) include irrigated land corresponding to 257.301 hectares in the whole region (ISTAT 2010). The ratio of irrigable/irrigated land reaches 45% (Reg. ER and CER 2007). The largest fraction of irrigated crop is orchard, followed by corn and vegetables.

According to 2010 agriculture census data, the most used irrigation system in Emilia-Romagna is sprinkler (59% of the total irrigated area; 151.238 ha) followed by micro-irrigation (24%; 61.976 ha). Furrow and border irrigation accounts for 12% of the total irrigated area (30.589 ha) and submersion irrigation only for 3% (7.139 ha). Sprinkler irrigation is used on all crops and in particular on open field crops such as corn and soy. Micro-irrigation is mainly applied to orchards and vegetables. The furrow and border irrigation are adopted in the western provinces of the region on permanent grassland and on corn. Submersion irrigation is still practiced on rice fields. However, the picture is different when considering the most important cash crops: fruit trees are mainly drip irrigated (up to 90% in many areas); vegetable for processing or fresh market (i.e. processing tomato, potato, snap beans, onion, lettuce, etc.) are micro-irrigated when cropped on land owned by the farmer and sprinkler irrigated elsewhere.

Certain trends in irrigated agriculture in Emilia-Romagna emerge from the last twenty years census data (1990, 2000 and 2010): 1) continuous decreasing of the number of farms with irrigated land; 2) progressive reduction of irrigated land in the 1990s followed by stability in the 2000s; 3) decline of low-income irrigated crop surface; 4) sharp decline in low efficiency irrigated methods (see table 1); 5) substantial increase in the micro-irrigation (see table 1). What seems to be happening is that the high costs of irrigation, associated with the current low remuneration of agriculture production, have led farmers to reduce low-income irrigated crops and expand the production of high-income irrigated crops (usually highly water demanding) using more efficient irrigation techniques (Reg. ER and CER 2007).

Table 3.1 Irrigated land in Emilia-Romagna per typology of irrigation technique (data from ISTAT-Agriculture Census 2000 and 2010; provided by CER)

Year	Sprinkler	Micro-irrigation	Furrow and border	Submersion	Other	Total
2000	162.522	37.673	45.308	8.074	7.021	260.598
2010	151.238	61.976	30.589	7.139	6.359	257.301
Variation (%)	-7%	+65%	-32%	-12%	-10%	-1%

3.2 Water demand and supply

Fresh water is relatively abundant in the Emilia-Romagna region although in recent years the modification of rainfall distribution (alternation of heavy rainfall and prolonged drought) has caused significant water deficit in some areas and trends indicate an intensification of the phenomenon.

There are 47 main river basins, 5 multiple-use artificial lakes, a dense network of artificial canals for irrigation and drainage (over 20,000 Km) and a number of important aquifers in the region. The Po River constitutes the northern border of the region and is the main source of surface water which has in general always ensured water supply in the Emilia-Romagna region. However, over the last 30 years there has been a reduction of about 20% in the average annual flow of the Po River with a reduction that in summer can reach up to 50% (MPAAF 2010). These changes are related to variations in the rainfall patterns.

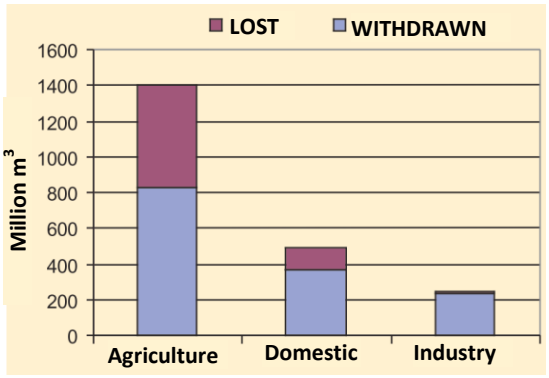
In addition to the Po River, the numerous streams on the Apennines Mountains provide some of the water needed to irrigate vast farmland in the southern area of the region. This source of water, however, is not always reliable in terms of quantity and availability in time. In general, Emilian Apennines streams (on the western part of the region) maintain a good water flow in summer and can meet water needs as opposed to the Romagna Apennines streams in the south-east part of the region which are often dry in summer. This factor coupled with the distance from the Po River have determined a situation of persistent water scarcity in Romagna that has been partly compensated by the construction of an artificial canal conveying irrigation water called Canale Emiliano Romagnolo.

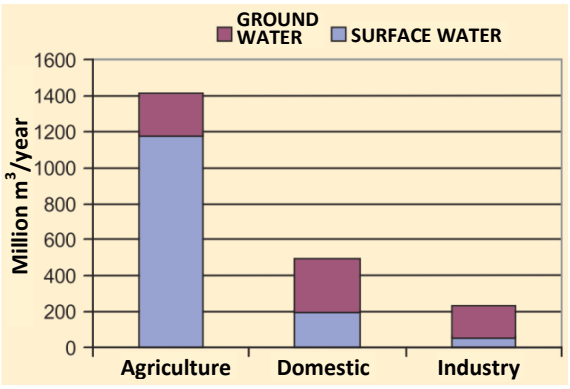
Precipitation replenishing fresh water is unevenly distributed in the region. Rainfall decreases from the mountains to the plain, and in general, moving eastward. Maximum precipitation values of about 2,000 mm/year are reached close to the Emilian Apennine ridge, whereas values of about 700 mm/year are common in the east side plain of the region. The regional average annual precipitation is about 750-850 mm/year falling over about 82 days (ARPA 2010).

The regional Water Protection Plan (PTA) approved in 2005 quantifies water demand and supply in Emilia-Romagna. The water demand of the region is 2,125 million m^3/year. Withdrawals for irrigation are estimated at about 1,400 million m^3/year (66% of the total demand). Domestic uses account for 487 million m^3/year (23%), and 232 million m^3/year are for industrial uses (11%).

Water loss during transportation amounts to about 698 million m^3 which corresponds to approximately 33% of the total water withdrawn. The agricultural sector is responsible for most of this water loss. Of the total water withdrawals for agricultural uses 41% (576 million m^3; Figure 2.1) is lost during transportation. The main reason for this is that the transportation network is generally constituted by uncoated canals

and only to a little extent by coated canals or water pipes. Significant heterogeneity exists on the regional territory, however. Taking into account this water loss, the water resource actually used in the region is about 1,426 million m^3 of which 829 million m^3 (58%) used by the agricultural sector, 365 million m^3 (26%) by the domestic sector, and 232 million m^3 (16%) by the industrial sector. The efficiency of water delivery to the farm is therefore 59%. Once water has reached the farm, efficiency increase up to 67% of the water delivered. In general water efficiency (water withdrawn/water used by the plants) is estimated to be about 40% in Emilia-Romagna (Reg. ER and CER 2007).





Source: Reg. ER and CER 2007

Figure 3.1 Water volumes withdrawn and lost during transportation per typology of water use

Figure 3.2 Water volumes withdrawn from different sources per typology of water use

Most water demand in Emilia-Romagna is satisfied with surface water (68%; 1,450 million m^3/year). The Po River is the main supply source, meeting 46% of the regional demand. Over 90% of the 980 million m^3/year withdrawn from the Po River is used for irrigation. Water withdrawals from the Apennine streams account for 417 million m^3/year. Half of this amount (212 million m^3/year) is used for irrigation. However, it is not sufficient to satisfy irrigation demand as an extra 81 Mm^3/anno would be needed (Reg. ER and CER 2007).

Water pumped from deep aquifers is estimated at 675 million m^3/year, 32% of the total demand. This amount is shared among the different uses as follow: 42% for domestic consumption, 25% for industrial uses and 33% for agricultural uses. Groundwater satisfies most industrial (74%) and domestic (60%) needs. The fraction of groundwater used by agriculture is limited to 16% (Figure 3.1). Groundwater withdrawals vary considerably between different areas reaching deficits (relative to the aquifer recharging capacity) in the provinces of Bologna and Parma.

3.3 Agri-environmental issues

Key environmental issues connected to agriculture and irrigation include:

- Subsidence. The Emilia-Romagna plain is subject to natural subsidence (a few millimetres/year) and human induced subsidence due to extraction of groundwater and hydrocarbons, and land reclamation works (several cm/year). The phenomenon is highly variable in terms of location and intensity. In general the situation is slightly better in Romagna whereas in Emilia subsidence is more serious reaching peaks of 4 cm/year in Bologna. One major problem related to subsiding land is salt

water intrusion into the aquifers which prevents the possibility to use groundwater for irrigation and domestic purposes in the coastal areas of Emilia-Romagna.

- Hydraulic and hydro-geological instability. Most of Emilia-Romagna territory is characterized by hydraulic and hydro-geological instability as well as erosion. About 59% of the low-lying area in the Emilia-Romagna plain is subject to mechanical drainage being it either perennial mechanical drainage (21%) or combination of mechanical and natural drainage (38%). Maintenance of the drainage infrastructural network is therefore of vital importance. As for erosion, it is estimated that 24% of the agricultural land in the mountain areas of the region suffer from erosion.
- Water pollution. With regard to surface water, the environmental quality of 52% regional river basins is classified as "sufficient" (target set by the PTA to be reached by 2008). The environmental quality of the remaining river basins is "poor" and in one case even "bad" (ARPA 2010). Organic pollution of surface waters, though decreasing, is higher than the average of European countries, while 28% of the regional plain is identified as vulnerable under the EU Nitrates Directive (pollution by nitrates from agricultural sources). As for groundwater, most regional aquifers are contaminated either by natural presence of heavy metals and minerals (57% of monitored stations mostly located in the plain and in Romagna) or by human-induced presence of nitrates, heavy metals, chemicals and pesticides (13% of monitored station mostly located in Emilia). Only 13% of monitored stations show good quality water.
- Maintain the Minimum Vital Flow (Deflusso minimo vitale – DMV). The DMV is the minimum water flow that needs to be maintained in a water body in order to ensure ecosystems quality and functionality. This parameter has been introduced by the regional Water Protection Plan (PTA). Many Apennine rivers in the region show water deficit below the DMV in summer. It is estimated that because of the need to maintain the DMV surface water withdrawals for human uses may be reduced up to 29 million m^3/year and groundwater extraction may be pushed up to 10 million m^3/year in Emilia-Romagna (Reg. ER and CER 2007; INEA 2009).

3.4 The Canale Emiliano-Romagnolo Irrigation District

The Canale Emiliano Romagnolo (CER) is an artificial water systems made up of a main canal and a number of smaller canals delivering water mostly for irrigation purposes in the Emilia-Romagna plain where water is scarce (provinces of Ferrara, Bologna, Ravenna, Forlì-Cesena and Rimini). The CER delivers water to a territory spanning over 3,000 km^2 characterized by presence of intensive agriculture, sprawled urban settlements and a number of important industries.

Construction started in 1955. The main stem of the CER is designed to be 150 km long and includes seven pumping stations. The last 15 km of the canal are still under construction and will extend water delivery to Rimini and its coast. Water flowing in the CER is withdrawn almost entirely from the Po River (water grant of maximum 68 m^3/s). The Reno River provides an additional 2 m^3/s. In total, over 300 million m^3/y are delivered to irrigated crops through the CER.

The planning, construction and management of the CER canal is responsibility of the Second-order Land Reclamation Consortium for the Canale Emiliano Romagnolo (CER Consortium), a public/private agency set up for this purpose in 1939. From 1959 the CER Consortium is also in charge of carrying out research on irrigation and providing technical assistance and training to farmers for the efficient use of irrigation water.

The First-order Land Reclamation consortia which are member of the CER Consortium are responsible for the distribution of the CER water according to assigned quota (water grants). They are (the numbers correspond to location on map in figure 2-right): Land Reclamation Consortium Burana (1); Land Reclamation Consortium Renana (2); Land Reclamation Consortium Romagna Occidentale (3); Land Reclamation Consortium Romagna (4); Land Reclamation Consortium Pianura di Ferrara (5).

To overcome increasing demand of water during periods of drought the CER is nowadays serving domestic and industrial uses next to irrigation. Now limited to situation of water deficit in summer, these uses are expected to increase in the future. The CER canal is not meant to be used to discharge drainage water, although it has happened on occasion.

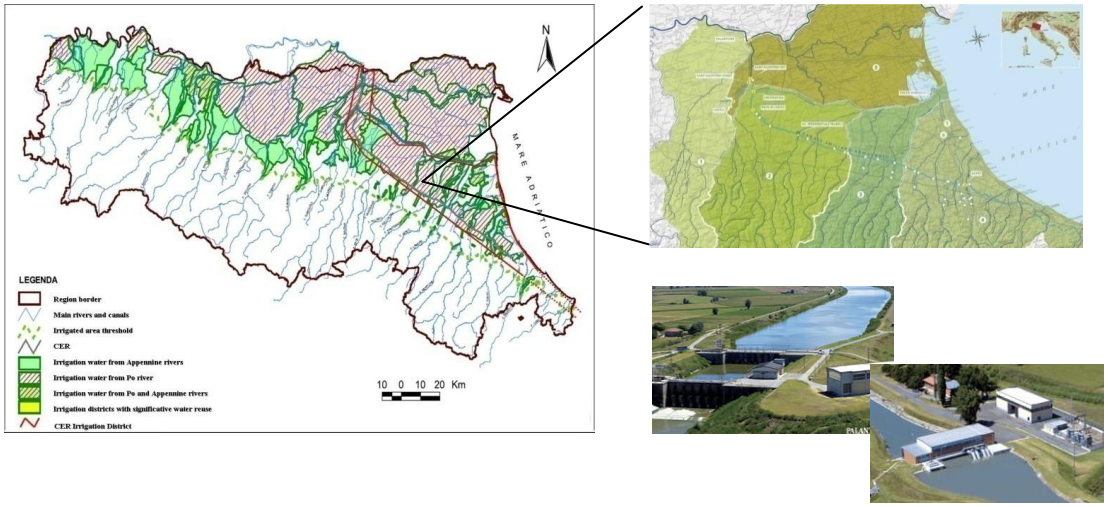


Figure 3.3 The CER district in Emilia Romagna, Italy

4 Results – existing irrigation water governance arrangements

This chapter illustrates the existing irrigation water arrangements in place in the case study area according the PAA dimensions. Each section of the chapter addresses one of the PAA dimensions and highlights key aspects of the water governance system.

4.1 Actors and coalitions

In the last twenty years, the water sector in Italy has undergone many transformations through a series of legislative reforms that have regarded water management paradigms, organizations, responsibility, and instruments. The European regulation and in particular the Water Framework Directive (WFD) has been a major boost to many of these transformations.

In terms of water management organizations, the process of reform is still going on as result of the recent introduction of water districts (in compliance to the WFD) and the Italian politics of rationalization of public agencies.

Major reforms of the Italian water governance system have started in 1989 (Law No. 183 of 1989) with the introduction of water boards which address water management at river basin scale. In 2009 the establishment of eight large water districts over the Italian territory (Legislative Decree No. 152 of 2006) has marked another important point of transition which is still far to be fully accommodated. Water district authorities will have to replace the existing water boards. However, at present they have not been established, and water boards of national importance (i.e. those in charge of national relevant river basins) have been given responsibility to elaborate and adopt the Water Management Plan of the districts (Law No. 13 of 2009).

In Italy, water management is responsibility of the regional administrations. According to all interviewees in Emilia-Romagna there are too many public agencies dealing with water management without being much coordination. The regional territory is covered by three water districts (i.e. Padano, Appennino Settentrionale and Appennino Centrale). While for the Padano District the water board of the Po River is in charge of the district management plan, the situation is not clearly defined in the Romagna part of the region where a number of water boards are involved without clear attribution of responsibility. According to one interviewee this situation is source of organizational and relational problems as there is not clear counterpart to refer to. Furthermore, at regional level there are at least four different departments in charge of water management:

- The regional department for environmental protection (Assessorato ambiente, riqualificazione urbana) dealing with water resources planning including authorizing water grants through the River Basin Technical Service (Servizi Tecnici di Bacino);
- The regional department of agriculture (Assessorato agricoltura, economia ittica, attività faunistico-venatoria) dealing with irrigation water management;
- The regional department of land, coast and civil protection (Assessorato sicurezza territoriale, difesa del suolo e della costa, protezione civile) dealing with flood management including infrastructural works on rivers;
- The vice-president of the Regional Council in charge of drinking water and waste water management.

In addition, any relevant water work (e.g. construction of large water reservoirs) and applications for obtaining water grants are subjected to Environmental Impact Assessment which is responsibility of the department of production (Assessorato attività produttive, piano energetico e sviluppo sostenibile, economia verde, edilizia, autorizzazione unica integrata).

When it comes to irrigation water management, however, interviewees are more positive. They report that clearly defined responsibility is assigned to a limited number of public organizations and that there is no ambiguity on "who does what" (see also rules section for more detail on this point).

Table 3.1 provides a list of key actors in the irrigation sector and a short description of their activity. There is agreement among respondents that the **land reclamation consortia** play a crucial role in irrigation water management. These organizations act at the interface between farmers and water management organizations of higher level. Their main task is to ensure mechanical water drainage through a team of technicians operating water pumps and other hydraulic systems throughout the consortium territory. The consortia also plan and ensure the distribution of irrigation water throughout a wide and knitted network of canals. Finally, consortia are in charge of maintenance and expansion of their water network.

Land reclamation consortia have a legal profile of public agencies but they are not properly public organizations as their members are private agents. They are not fully private organization either, having a hybrid status of "public agencies made up of private agents". The members of a consortium are all edifice and land owners on its territory including industries, businesses, and houses. Because members benefit from a number of services (namely drainage, irrigation water distribution, and increasingly water distribution for industrial and domestic uses) they are requested to pay a contribution to the consortium. This is neither a tariff nor a tax as water is a public good that cannot be traded in Italy. What members pay is the service provided by the consortium. The contribution is entirely meant to fully cover water drainage and distribution costs, administrative costs, and ordinary and extraordinary maintenance costs. The members directly elect their representatives to the consortium board.

This typology of organization is unique of the Italian juridical system. It has both advantages and disadvantages for the management of irrigation water. The main advantage reported by interviewees is that farmers are more involved in irrigation water management because they have direct access to key public agencies through their representatives on the board. Some, however, point to a problem with representation as only a minority of citizens vote for the board. For instance, only 1-2% of farmers vote for the consortia boards. One reason of this limited participation is that water scarcity is a relatively new problem. As long as water was available farmers had no particular interest in the consortia activity except for the fact that they wanted their land to be secured with proper water drainage. The situation is however changing. Farmers are now more concerned about water scarcity and therefore more attentive to how the consortia manage water. The reason for the scarce participation of other societal groups is also to be found in the fact that water has always been available. As an interviewee puts it "people do not experience any water problem as water always come out of the tap and land is always dry, therefore they do not understand why they have to pay the consortium contribution and have to vote for the board". Indeed, several interviewees saw a problem in the lack of communication between consortia and their members about role and functions of a land reclamation consortium.

Under the agenda of rationalization of public agencies currently dominating the Italian political debate, the Emilia-Romagna regional administration has recently reformed the structure and organization of land reclamation consortia (Regional Law No. 5 of 2009). Out of a process of aggregation there are now 8 consortia down from 16. In general, interviewees point to two main problems related to this reform: 1) aggregating territories having different irrigation management traditions, infrastructure, problems, and ways of calculating the contribution will require the new consortia long time to adjust their technical and administrative apparatus; 2) the institutional reorganization of personnel, offices and functions inevitably raises power and authority conflicts that will take time to settle.

As for the outcome of this aggregation, respondents' have different opinions. Some see the aggregation as political strategy to gain citizens consensus in times of increasing lack of trust in politics. They argue that no significant financial savings are being made because the reform does not include cutting jobs. Furthermore, administration costs account for about 1-2% of the consortia budget. Therefore - they say - there will not be any economic benefit for the members (i.e. no reduction of the contribution to pay). Other respondents are more optimistic, reporting that despite initial conflicts and difficulties the consortia are likely to benefit from the internal institutional reorganization in terms of improved efficiency of the offices. Moreover, each new consortium will have to review the existing contribution systems, creating a unified one. The expected increased homogeneity is perceived to make the contribution system more equitable in the whole region. In general, respondents agree that it is too soon to foresee if the reform will increase efficiency or not as the process has just started. There is one point on which all interviewees agree upon with regard to this matter: further aggregation of the consortia would be detrimental. The main reason is that becoming bigger would disconnect the consortia from their members. This would result in loss of efficiency of the services offered.

As for the **CER consortium,** respondents attribute to this organization a strategic role in irrigation water management. On the one hand, the CER consortium is a very operational organization deeply rooted in the territory thanks to its research activity involving farmers, technology producers, first-order consortia, regional and local public organization. On the other hand, the CER consortium has develop a network of relations with higher institutional levels where key decisions about irrigation water management are made (regional, national and also European) thanks to its role of managing a national relevant infrastructure as the CER canal and the participation to national and international relevant research projects.

The **regional department of agriculture and the department of environment** are also considered key actors in irrigation water decision making. The regional department of environment is in charge of managing water uses. To this purpose it elaborates and adopts the Water Protection Plan (PTA) which outlines the measure to achieve a good state of water quality, calculates the water budget and identifies water conservation measures including the Minimum Vital Flow (DMV). The regional department of agriculture is in charge of irrigation water management including regulating the reclamation consortia. Specifically the department finances research and projects on irrigation water efficiency and allocates CAP funds through the Rural Development Plan. The allocation of part of these resources is conditioned to the respect of agri-environmental measures and the adoption of efficient irrigation technology. On an everyday basis, policymakers and public officers of regional departments are committed to cross-scale and cross-sector collaboration for water resources planning being conflicts relegated to the political domain, say interviewees.

As for private actors a key role is played by **farmer unions** which represent farmers' interests in the different political and policy arenas. Particularly prominent is the role of Coldiretti, the national union of farm owners. In Emilia-Romagna alone Coldiretti represents more than 45% of farm owners. Labour unions represent farmers' interests through the board of a number of land reclamation consortia as well as through the association lobbying activity in different political and policy arena. For example, Coldiretti holds the presidency of the board of four land reclamation consortia, that of the CER consortium, and that of the regional association of land reclamation consortia (URBER).

Table 4.1 Key actors in irrigation water governance in Emilia Romagna

Typology of organization	Organization	Description of activities relevant for irrigation water management
Public organizations	European Union	It regulates the agriculture sector (CAP) and the water management sector (Water Framework Directive)
	Ministry of agriculture	It adopts and finances the National Irrigation Plan for construction of national relevant irrigation infrastructure (e.g. the last 15 km of the CER canal)
	Po River water board	It grants water withdrawal authorizations for the CER water
	Emilia Romagna Region – Agriculture department	It regulates land reclamation consortia and irrigation water management, and provides incentives to irrigation water efficiency (mainly allocating CAP funds through the Rural Development Plan)
	Emilia Romagna Region – Environmental department	It plans water resources, including the regional Plan for Water Protection. It grants water withdrawal authorizations through the River Basin Technical Service.
	Provinces	In Italy there are four administrative levels: state, regions, provinces and municipalities. Provinces approve the Provincial Spatial Plan which integrates the measures of the regional Plan for Water Protection. They also invest in communication campaigns to farmers about regional financial opportunities and initiatives.
	Land reclamation consortia	There is one second-order land reclamation consortium (CER Consortium) and eight first-order land reclamation consortia. Land reclamation consortia are in charge of mechanical drainage and irrigation water distribution to farmers over their territory. The CER consortium is responsible for the construction and maintenance of the CER canal, distribution of the CER water to the first-order consortia and farmers as well as for research on irrigation.

Typology of organization	Organization	Description of activities relevant for irrigation water management
Private organizations	Farmer labour unions	There are four major labour unions and a number of smaller ones in the region. The biggest one, representing over 45% of regional farm owners is Coldiretti. They represent the interests of farmers into political and policy arenas.
	Producers associations	They are cooperative companies of farmers. They buy crop from the associated farmers and then sell it to the national and international market as it is or after processing (many of them have also food processing plants). The biggest European fruit and vegetable producers association (named APO CONERPO) is based in Emilia-Romagna.
	Voluntary irrigation consortia (Consorzi irrigui volontari)	Association of farmers who manage irrigation water they are granted to withdraw (e.g. group of farmers who share an inter-farm water reservoir). They typically build the infrastructure and the network needed to store and distribute water. They are often supported by the land reclamation consortia in planning the infrastructure.
	Producers of irrigation technology	Companies producing and selling irrigation technology (drip, sprinkler, etc.)
NGOs	Environmental organizations	The regional departments of a number of environmental organizations such as Lega Ambiente, Italia Nostra and WWF acts on different regional political and policy arenas to defend the interests of the environment, including water conservation.

Turning to the topic of coalitions, it appears that while in ordinary situations stakeholders tend to act independently in water political and policy arenas, coalitions do manifest in times of water scarcity. In these circumstances political conflicts erupt at the level of regional departments where the environmental protection discourse (i.e. the need to respect the DMV) clashes with the need to support the agricultural economy discourse. Typically two opposing coalitions manifest: on the one hand the agriculture coalition including labour unions, producers associations, the regional agriculture department and to some extent the Land Reclamation Consortia voice for the needs of farmers to irrigate their crops; on the other hand the environment coalition including regional environmental department and environmental organizations claim the need to respect the DMV to ensure ecosystems functions on the ground that it is necessary to adopt a long term view of water resources conservation. The CER consortium often plays the role of mediator between these opposing coalitions. Reconciling different interests, however, seems to depend on the flexibility and willingness to accommodate problems of single individuals. On this point, a number of interviewees report that the political dialogue between the department of environment on the one hand and farmer unions and the agriculture department on the other hand has become more difficult under the current legislature because of unwillingness to compromise on both sides.

Main observations

- Water governance in Italy and in Emilia-Romagna is fragmented, with a number of agencies at different scales in charge of water management, i.e. water boards, regional departments, provinces, land reclamation consortia.
- Irrigation water management is clearly organized, and "who does what" is unambiguous and transparent.
- Despite differences in views and interests, public administrations are committed to vertical and horizontal cooperative planning and policy-making. Conflicts arise at political level.
- Two coalitions are identified in this report: agriculture and environment. These coalitions tend to clash in times of water scarcity. In these situations the conflict of interest between agricultural production and environmental protection erupts. The CER consortium tends to play the role of the mediator between the opposing coalitions.

4.2 Resources

There are two relevant findings on this dimension: the first regards knowledge and expertise; the second concerns the lack of financial resources for renovation and maintenance of the irrigation water network.

The first main finding is that scientific knowledge on irrigation efficiency is well developed in the CER district. However, there is still room for improvement, particularly in the areas not reached by the CER consortium services.

All interviewees have stressed the fundamental role played by the CER consortium in generating and spreading scientific research on irrigation efficiency. The CER consortium has been charged with responsibility of conducting research on irrigation water efficiency since 1959. At present about one-fifth of the CER consortium staff is involved in research and two-fifth of it is providing technical support to farmers and first-order land reclamation consortia. The CER research also provides fundamental support to regional policy-making on agriculture.

Over the years the CER consortium has developed and applied research on plant/water relation, irrigation water management modelling, and efficiency of water technologies. Particularly, the CER consortium has developed a web-based irrigation scheduling system called IRRINET which provides irrigation advice to farmers for the main irrigated crops. The service is free of charge to all registered farmers who receive the irrigation advice for the specific crop of their farm by phone (via text message) or through the IRRINET web application. The IRRINET system is based on years of research and a large number of data about soil, climate, plants, water table levels, and farm geo-referenced data which are combined with information about crop and irrigation systems provided by the farmers. The irrigation advice consists of information about the daily water requirement, day of irrigation, water volume and duration of irrigation for a specific crop of a specific farm. This system allows saving water by calculating the exact amount and scheduling of the irrigation in order to get the highest water efficiency in terms of irrigation versus crop output. Furthermore, the system also advices on when it is convenient not to irrigate because useless or even harmful for the plant (e.g. in summer 2012 when during a prolonged drought combined with a heat wave irrigating specific crop became useless).

At present there are 2.350 users registered to the IRRINET service corresponding to about 23% of irrigated land in Emilia-Romagna. The CER consortium has estimated that the introduction of IRRINET leads to save about 50 million m^3 of water per year. The benefit for the farmer is also significant. Compared to traditional irrigation approaches (i.e. farmer experience on when and how much to irrigate) there is a yield increase of about 13% using 27% less water (CER 2012). IRRINET has been adopted by the National Association of Reclamation Land Consortia and is now used in six other regions in Italy under the name of IRRIFRAME.

The CER consortium is also actively involved in organizing training programs for farmers on the use of IRRINET, on irrigation water efficiency, and the selection, correct installation and use of water saving irrigation systems. It also organizes and promotes information campaigns on irrigation water efficiency. The regional department of agriculture financially supports these training programs and information campaigns as well as training programs organized by producer organizations. On this issue, respondents stress the need for more technical assistance and training to farmers arguing that often insufficient knowledge on how to properly use the technology may lead to wasting water even with highly efficient technology such as micro-irrigation. Unfortunately financial resources for training and information campaigns are insufficient and not regularly available thus these programs lack continuity.

In addition to the training activity, the CER consortium, with the regional sponsorship, has installed a “demonstrative field” where local farmers (but also other national and international interested parties) can see the results of experiments conducted on different crops with different irrigation technologies. Regular guided tours to the field are organized where participants can see, have explanation, ask questions thus learning about the efficiency of different irrigation technologies. Furthermore, the CER consortium closely cooperates with the regional network of “experimental farms” established and supported by the regional agriculture department. These farms have agreed to dedicate part of their land to conduct experiments for example on irrigation water efficiency. These experimental projects are sponsored by the regional agriculture department and conducted in close collaboration with the CER consortium which provides technical and scientific support.

The regional agriculture department has invested substantial resources in irrigation water efficiency and has made irrigation water efficiency one of its priorities over the last years. Next to the aforementioned experimental farms, the agriculture department has sponsored the development of IRRINET. Another interesting example of regional sponsored research is the 2011 call for financing the improvement of farm irrigation systems. As selection criteria to allocate the resources, an efficiency index has been developed for each different irrigation technology. For the definition of the efficiency index the agriculture department, the CER consortium together with the experimental farms, the regional environmental protection agency (ARPA), farmers unions, producer organizations, and producers of different irrigation technologies have worked together. Although the process was controversial and conflicts arose, an agreement was reached. One interviewee considers this to be a major achievement, despite the little resources to be allocated by that specific call. This efficiency index in fact could be used in a number of different situations (including future calls) to guide the allocation of resources to more efficient technologies. On a different ground, the regional agriculture department has also financed the installation of a number of piezometers in the region to measure water levels in the soil. Initially doubted, this investment proved useful to understand the water dynamics in the soil top layer and the data are now used by the SIRRIMED system to calculate the water balance and the water needs of the plants. These examples reveal that the regional department has

taken on board the water saving problem. However, respondents lament the increasingly less availability and the irregularity of regional financial resources for research, partly due to the current economic contingency. However, according to one respondent there is capacity to give continuity to projects when funds are made available.

As for the first-order land reclamation consortia, they do not have responsibility to conduct research themselves although they are also called to take water saving actions. For them the research activity of the CER consortium is therefore crucial. The CER consortium supports its member land reclamation consortia in the implementation of IRRINET and keeps them up to date on their research results. Some land reclamation consortia have also developed their own strategy to improve irrigation water saving. For example, the consortium of Emilia Centrale has activated a call centre to collect irrigation water demands in order to be able to better plan water distribution (before that farmers used to inform the local technician of the consortium of their need for water to irrigate their crop). The consortium of Romagna, instead, has developed in collaboration with the CER consortium a weekly bulletin on the state of the water resources providing information on water availability as well as irrigation advice.

The above suggests that there is learning capacity in the CER district in terms of generation and practical application of new scientific knowledge and expertise. There is also capacity of the CER consortium to build networks and relations of trust with the involved parties. The success of IRRINET (also adopted at national level) as well as training and information campaigns have brought great visibility and credibility to the CER consortium. On the one hand, the CER consortium has become the regional reference point for research on irrigation. On the other hand, the fact that the CER consortium carries out applied research directly addressing the problems and needs of farmers has also gained the consortium the trust of farmer unions and producer organizations. This in turn has granted the consortium some mediation power in irrigation water controversies.

According to a number of respondents, the origin of this learning capacity is to be found in the foresighted decision to invest in the construction of the CER canal and in the good fortune of having visionary policy entrepreneurs on the right place and moment in time. The construction of the CER canal marked a turning point in the economy of the Emilia-Romagna, making irrigated agriculture a key resource for the regional economy. Around this investment much knowledge, expertise, research have developed. The regional government has chosen to invest in irrigated agriculture as source of economic growth of the region, thus devoting substantial financial resources to this sector over the decades. Nowadays, with increasing problems of water scarcity and water use conflicts, the CER canal is becoming a national strategic infrastructure providing more and more often water also for domestic and industrial uses. Therefore, respondents say, in retrospect it was a forward-looking, worthwhile investment. Furthermore, they say, tasking the CER consortium with responsibility to study and teach farmers how to use irrigation water efficiently in the late 1950s was a great intuition of one policy-maker at the Ministry of Agriculture who had a research background. Times were favourable and there was the possibility to make this idea operational by starting a research office. The combination of these factors has generated today's capacity building of the CER consortium.

The second main observation on the resources dimension regards the consequences in terms of water efficiency of lack of resources for maintenance, renovation and construction of new drainage and irrigation water infrastructure.

To understand this point, some background information on the financing and water distribution system of the consortia is needed. There are major territorial differences in the Emilia-Romagna region and in the CER district with regard to water delivery systems and pricing. The most efficient water distribution system is through pressured pipes. With this system, water loss is limited as compared to uncoated canals, the calculation of water usage is precise because there is a meter counting the volume of water used and farmers do not have to pump up water from a canal thus saving energy costs. However, although expanding especially in the CER district, this is not yet a wide-spread water distribution system. The most common situation consists of a knitted network of artificial uncoated canals where the water level is controlled by the land reclamation consortia (as often these canals are used both for drainage and irrigation). From these canals farmers are authorized to pump water for irrigating their crop. Depending on water demand and supply and the distribution network these authorizations are different. For example, in areas where water availability is limited or the network is not sufficiently wide farmers are allowed to withdraw water on shifts and for a limited number of hours. There are also areas without water infrastructure, such as nearby Rimini where the CER canal is still incomplete or outside the CER district. Here farmers withdraw water from wells or local small rivers but this is often insufficient to satisfy the demand.

As for financial resource, in general, each first-order land reclamation consortia manage its own drainage and irrigation network of canal and water infrastructure. This includes expanding the canal network because of urban expansion or increased irrigation needs. Costs are entirely covered by the land reclamation consortia with the contribution paid by their members (this contribution is the only economic resource of the consortia). The CER consortium manages the CER canal with the contribution paid by the first-order consortia withdrawing water from the canal. Land reclamation consortia have different ways of calculating the contribution to be paid by farmers for irrigation water. The contribution is always “binomial”, i.e. there is a fixed quota per hectare and a variable quota accounting for the volume of water used. The calculation of the fixed and variable quota may vary considerably from one consortium to another. For example, where information about cultivated crops is available to the land reclamation consortia, the fixed quota is different depending on the cultivated crop (the more water demanding is the crop the more for the farmers to pay). As for the variable quota, the price is higher per cubic meter in case of water delivered via pipes. In general, calculation of the variable quota is less accurate when there is no meter installed at the farm.

There is a number of problems, especially in terms of irrigation water efficiency, associated to these systems of distributing and pricing water. First, some irrigation technologies need continuous flux of water and are therefore not compatible with distribution on shifts. This is the case of micro-irrigation technology that is the most efficient irrigation system. Therefore, the water distribution infrastructure is a limiting factor to increase irrigation water efficiency. Second, all respondents agree that most of the consortia water network is old (in some cases ever more than one hundred years) and needs renovation and that in some areas it also needs to be extended to reach farmers who do not have water. Some parts of the CER canal itself needs renovation of the coating. This old network is source of significant water loss up to 41% of the water transported. Part of this loss is due to the fact that the canals are uncoated and therefore water infiltrates in the ground. On this point, however, some respondents report that the infiltrated water has the important function of contrasting subsidence and of maintaining soil humidity. Third, the increasing urbanization puts additional pressure to the consortia mixed irrigation and drainage network as the

more land is coated the more mechanical drainage is needed in low-lying areas, thus requiring continuous expansion of the network. Therefore, major investments are needed by the consortia on the irrigation and drainage network. However, the contribution paid by the consortia members barely covers ordinary maintenance costs and planning extraordinary works or additional infrastructure is hardly possible.

One final partly related observation on resources pertains to the allocation of regional resources to farmers. A number of interviewees question the current regional system of financial resource allocation and specifically the Rural Development Plan. They argue that to really support water efficiency instead of evenly distribute resources a rewarding system should be implemented granting benefits to the farmers who have invested in greater water efficiency. Some other respondents observe that the Rural Development Plan could also finance infrastructural works in the water network.

Main observations

- The CER consortium is the regional reference for research on irrigation efficiency; it organizes training programs for farmers and information campaigns on efficient irrigation and water saving measures.
- Scientific knowledge on irrigation efficiency is well developed in the CER district. However, there is still room for improvement particularly in the areas not reached by the CER consortium services.
- The regional agriculture department has invested much resources on irrigation and water saving research, training and information campaigns. However, resources are increasingly less available due to the current economic crisis.
- There are major territorial differences in Emilia-Romagna and in the CER district with regard to water delivery systems and pricing. The most efficient delivery system is through pressured pipes. Although expanding especially in the CER district, this is not yet a wide-spread water distribution system. The most used delivery system is through a network of uncoated canals from which farmers can withdraw water according to the license they have received (typically they are allowed to withdraw water on scheduled days and hours). As for the contribution, this is made up of two parts: there is a fixed share per hectare and a variable share accounting for the volume of water used. The measurement of quantity of water used is not precise in most cases where a meter is missing; in cases where there is a meter, measurement is precise.
- The water distribution infrastructure is currently not optimized from the perspective of irrigation water efficiency. Micro-irrigation is not compatible with water distribution on shifts which is common where there is lack of sufficiently wide water network or lack of water availability. Water loss during distribution is up to 41% due to aging infrastructure and infiltration in uncoated canals.
- There is limited capacity at the local level to invest in new infrastructure. Major investments are needed by the land reclamation consortia on the irrigation and drainage network. However, the contribution paid by the consortia members barely covers ordinary maintenance costs and planning extraordinary works or additional infrastructure is hardly possible.

4.3 Rules of the game

With regard to division of responsibility, it was already pointed out earlier in this report that water policy decision-making is highly decentralized and fragmented in Italy. The advent of river basin organizations (water boards in the 1980s and water districts in 2006) without any real reorganization of water institutions is often blamed for this fragmentation. Most interviewees describe decentralization as positive for irrigation water management because it brings public organizations more in contact with farmers and their needs. However, when it comes to water management issues such as allocation one major consequence of this decentralization is that each region has its own water strategy, objectives and management structure and acts individually on national and international water policy arenas. Respondents consider this to be a problem, particularly because inter-regional coordination on water management is largely insufficient. Furthermore, they point to the lack of regional coordination as reason for inability of the national bureaucracies to represent the interest of the country in international water policy and political contexts which in turns often lead to Italy being subjected to European decisions.

One major consequence of this highly fragmented water governance system is excessive bureaucracy. A couple of interviewees provided a key example on this point. To ensure stable and long lasting water supply building reservoirs is one of the water conservation measures adopted and financed by the regional government and supported by producer organizations and farmer unions. However, implementing this policy is particularly difficult because as one respondent says “it takes up to four years to obtain the required permits to build small scale reservoirs, and at least twice as much for a large reservoir let alone the long lasting, time consuming political conflicts arising when a project for a large reservoir is presented”. In general, respondents agree on the need for improving simplification and clarity of both legislation and bureaucracy. This requires, says respondents, a radical reform of the whole environmental legislation in the direction of greater coherency and transparency in attributing responsibility to the different vertical and horizontal levels of government.

Looking at rules and procedures for decision-making, it appears that the Emilia-Romagna region is going through times of institutional change in irrigation water governance. In 2010, the regional law No. 5 of 12 February has redesigned the rules for electing the board of the land reclamation consortia. Irrigation has traditionally been (and still remains) the main use of the consortia water. This has so far justified the fact that agriculture has been (and still is) the sector with the largest representation in the consortia board. This situation however has become source of conflicts as soon as the consortia water has started to be used for other purposes. Especially the CER canal water is increasingly used for domestic and industrial purposes due to more frequent droughts and expanding urbanization. This law goes in the direction of a more balanced representation of interests in the consortia board, say interviewees, thus responding to the increasing diversification of uses of the consortia water. However, as one interviewee points out “much more could and has to be done on this matter; this is just the first step in a process that will inevitably lead to a larger representation of other sectors in the consortia board in the future”. In general, the fact that involved stakeholders were able to come to an agreement to reform this law is seen as positive sign of willingness and capacity to adjust to changing circumstances.

When it comes to practical decisions on irrigation water management on the field, a practice often in use within the consortia is that of the so called “comitati irrigui” (i.e. irrigation water management committees). These are committees coordinated by

experts of the land reclamation consortia and made up of farmers who have to share part of the distribution network (e.g. pressured pipes or part of a canal). These committees are established to discuss irrigation water management, allocation and payment on that specific shared waterway.

Turning to rules of interaction among actors, the analysis revealed that regional water management planning is the result of numerous consultations involving regional departments, provincial governments, river basin organizations, representatives of the involved sectors (agriculture, industry), representatives of organized citizen groups and environmental groups (e.g. Legambiente) as well as private organizations such as companies producing irrigation technologies when relevant. Respondents report that due to the current economic crisis, parties are more willing to cooperate as resources are scarce and problems urgent. However, they say, the approach is more of solving short-term contingencies rather than long-term strategic planning. As for strictly agriculture related issues, a decision making system in place is the so called "consulta agricola". This is a regional discussion group where representatives of the agriculture sector (usually farmer unions but in case of technical discussion also producer organizations are invited) are presented programs, plans, policies and regulations being discussed by the regional government regarding the agriculture sector. Ideas, proposals, problems and solutions are discussed, including irrigation water issues. This institution is unique of the agriculture department of the region and it is intended for the region to get a better understanding of and be more responsive to the needs of the agriculture sector.

In addition to ordinary decision-making procedures, in times of water crisis two forms of extraordinary decision making procedures are activated. In case of particularly critical situations, the so called "cabina di regia" is established. This consultation takes place at the highest political level, involving the regional councillors of the sectors involved (together with policy-makers and public officers of other public organizations involved such as provinces, water boards, etc.) as well as representatives of the interested private sectors. An example of this sort is the "cabina di regia" established to solve the water crisis of the Trebbia river in summer 2012. In addition to that procedure, there are thematic discussion groups established to address specific contingencies. These meetings do not involve politicians but only policy-makers and representatives of the sectors involved. For instance, the thematic discussion group on the Reno river is coordinated by the regional environmental department and has been established to address the problem of the Reno river water allocation to different uses (hydropower, domestic, irrigation) in situation of water scarcity. According to interviewees these decision-making arenas are useful coordinating moments allowing bypassing institutional fragmentation. They all agree on the need to establish similar coordinating institutions to address water problems on an everyday basis and not only in times of water crisis.

Main observations

- Each regional government has its own water strategy, objectives and management structure and acts individually in the various water policy arenas. Because of this regional approach coupled with insufficient inter-regional coordination on water management issues the capacity of the national bureaucracies to represent the interest of the country in international water policy and political contexts is limited which in turns often lead to Italy being subjected to European decisions.
- The large amount of rules and red tape associated with water management make it difficult to invest in new irrigation water infrastructure, including water reservoirs.

- The recent reform of the election system for boards of the land reclamation consortia moves in the direction of a more balanced representation of water users' interests in the consortia board. However, additional reforms will be needed in the future to reflect the increasing diversification of uses of water supplied by the consortia.
- A number of procedures are in place for addressing water crises, including the establishment of the so called "cabina di regia" at political level and a number of thematic discussion groups at policy-making level. These coordinating institutions bypass the fragmentation of responsibility and respondents think it would be useful they were established on a permanent basis.

4.4 Discourses

Interviews with stakeholders revealed different ideas and perspectives revolving around the topic of irrigation water efficiency and water pricing.

The concept of irrigation water efficiency is framed differently depending whether it is considered from an agricultural perspective or an environmental perspective. The agriculture perspective is put forward through different narratives:

- "Irrigation water efficiency is about water used in relation to output (agriculture production) rather than only about total amount of water used by the agriculture sector as the environmentalists see it". In this view increase water efficiency and productivity is important because it implies less production costs (i.e. less water and energy for pumping costs), which is vital for maintaining the competitiveness of the irrigated agriculture sector on the global market.
- "Water not reaching the field is not lost". Rather, say some interviewees, water that does not reach the plant re-enters the water cycle providing environmental services such as contrasting subsidence by infiltrating the ground and increasing the soil humidity to the benefit of the environment and the cultivated plants. In this regard, these interviewees consider the environmental perspective to be reductionist because it looks at water deficit (i.e. difference between water withdrawals and water reaching the field), and this - they say - does not account for the complexity of the water problem.
- "Governance of water requires governance of the territory and of the rural economy", says another interviewee. Irrigation water efficiency has to be considered from an integrated management perspective embracing rural economy and land management. For instance, the farm economic structure influences the choice of the irrigation system, therefore affecting efficiency. In Italy the farm is typically small-medium size, often family conducted. Tenant farming is also very common and usually based on short term land rental contracts (1-3 years). Installing efficient irrigation systems such as micro-irrigation is expensive and therefore either not affordable in small farms or not a convenient investment for tenants as the micro-irrigation infrastructure is not movable. Some irrigation systems are also labour intensive and therefore not easily adopted. Another example regards the choice of crop to cultivate. This is highly influenced by the European CAP. Maize is now subsidized to generate bio-fuels, thus widely cultivated also in Emilia-Romagna. Maize however is a water demanding crop (e.g. in 2012 due to severe drought maize fields were extra irrigated). Water efficiency is therefore lost in the name of green energy.

- "Technology is not a panacea" is another argument used by interviewees. Micro-irrigation when not used properly can be inefficient. This situation tend to happen because of lack of information on how to use the system, thus more training support to farmers is needed. Furthermore, micro-irrigation requires continuous access to water, which means that it cannot be used where water can be withdrawn for a few hours or is distributed on shifts. Efficiency at farm level cannot be pushed beyond the limits of the existing technology; the water distribution network needs to be improved in order to increase efficiency.
- "Agriculture is pointed out as wasting water, but water is also wasted by households who do not have the perception of water scarcity. For farmers water is a production factor that is highly respected although there is still not much consciousness on the relation between water used and production" says another interviewee. In general, interviewees agree that farmers approach to water is changing towards a greater understanding that water is not unlimited. However, still much work needs to be done in this regard and there are major regional differences. For example, old generation farmers still tend to think that irrigating a bit more the field is good for the plants. Young farmers instead are interested in investments that can improve their income including adopting more efficient irrigation systems. This is for example the reason for the increasing use of micro-irrigation, rather than the establishment of a culture of water saving. Developing a culture of saving water takes long and requires investing in information campaigns not only directed to farmers but also to other users.

The environmental perspective to irrigation water efficiency is quite different. Narratives that interviewees put forward include:

- "The total amount of water is limited and it is necessary to ensure all water uses. In times of drought the amount of water available is not sufficient to satisfy the needs of all users. Therefore conservation measures in all user sectors are needed".
- There is in general lack of awareness that water is limited. Farmers tend to think that water is for their use, whereas households do not really perceive water scarcity as water always comes out of the tap.
- "Irrigating the fields at noon in summer is not efficient; as it is not efficient to use drinking water for irrigating golf courses" says one interviewee. Each user sector (agriculture, domestic, and industrial) has to do its part in implementing water saving measures. Saving water can be done in many different ways. In general farmers are not much aware of how efficiently they use water. For instance, micro-irrigation systems are efficient and should be widely implemented, whereas submersion irrigation should be abandoned. Thus, more information on water saving options needs to be provided to farmers. The same applies to households, who are not aware that they could use water more efficiently, for example by installing water saving filters on taps.
- Although some irrigation water is returned to the ground via percolation approximately 70% of water abstracted does not return to a water body. And for the water that does return, the return time is long and typically occurs when water scarcity is over and therefore that water is not really needed anymore.
- Water conservation and environmental protection are objectives of the European WFD. The Minimum Vital Flow (DVM) has been introduced to the purpose of ensuring environmental protection. Failing this objective can lead to European infraction and to major costs for the whole community.

Irrigation water pricing is subject of major debate. As already pointed out, there are substantial regional differences on water pricing systems. According to the pricing system they are familiar with, interviewees have different ideas on the issue. In general, the perception of respondents is that the current irrigation water price is barely sustainable for both farmers and consortia.

A number of interviewees have pointed to the fact that whether irrigation water price is fair or not depends on global food price and on the capacity to fully recover water delivery costs. When the food price drops, it is often difficult for farmers, especially small ones, to make a viable income out of irrigated crops, thus irrigation water is considered too expensive. As for fully recovering water delivery costs, this is difficult for land reclamation consortia who still have contribution systems based on irrigated surface and not on real water consumption. For example, one variable cost for the consortia is electricity to pump up water in the network. When water demand is high (e.g. in times of drought) the electricity bill for the consortia increases considerably. To this extra cost however there is no corresponding equal extra revenue in all cases where water is paid as fixed quota per hectare. Thus, this is a loss for the consortia. Usually loss is compensated is by cutting maintenance costs of the water infrastructural network.

Some respondents support the idea that irrigation water price should be differentiated according to uses and specifically that irrigation water should have a lower price than water used for other purposes. One respondent uses a turn of phrase to make this point saying that “consuming water is different from using it; consuming water implies polluting it, using water means making it productive”. The word “consuming” is used to indicate that water is withdrawn, exploited in the production process and then returned to the environment with lower quality (i.e. polluted) as in the case of water used by the industry. In contrast, irrigation water is “used” by farmers in the sense that it is turned into organic matter (i.e. food) for human consumption. Thus, irrigation water should have lower price than water used for other purposes because it feeds humanity without being returned polluted to the water cycle. A recurrent argument put forward by respondents favouring the differentiation of water price is the need to include environmental externalities in the calculation of water price. For example, substituting groundwater with surface water for irrigation is fundamental to reduce land subsidence. In contrast, groundwater withdrawal for domestic and industrial uses aggravates subsidence. This should be accounted for in the water price calculation, says one respondent. Another stakeholder picks up on that saying: “everybody has to pay for the positive environmental externalities generated by the use of surface water instead of groundwater; this extra resource could be used to improve the water network so as to further limit the use of groundwater in agriculture”. Another respondent justifies water price differentiation by pointing to the importance of maintaining the rural economy. There are areas in Emilia-Romagna where the local economy is mostly based on agriculture. As irrigation water is a major cost for farmers, adopting a policy of relatively low irrigation water price is seen by the regional and local governments as necessary for the survival of the local rural economy and the maintenance of typical elements of the landscape.

Drastic positions also were expressed on this matter. When asked whether the price of water is fair one stakeholder answered with a case in point: “Compare the water, electricity and gas bills that you receive at home” the person said “the price of water is one order of magnitude lower than that of electricity and gas. This is not to say that water should be as expensive as electricity and gas but for sure the price of water is too low and this is not supporting water saving. There is definitely room for improvement on this matter”. A number of interviewees, on the other hand, believe the

price of water is already high, reaching sometimes up to 5% of agriculture production. They argue that the current situation is taking the sustainability of the regional agriculture to its limit which may imply for a number of farmers to abandon agriculture. It is necessary to avoid reaching this tipping point - they say - as the consequences for the regional economy and for management of the territory would be disastrous.

Main observations

- The concept of irrigation water efficiency is framed differently depending whether it is considered from an agricultural perspective or an environmental perspective. According to the agriculture perspective water efficiency has to be seen in terms of water used versus agriculture output. In this view increase water efficiency and productivity is important because it implies less production costs (i.e. less water and energy for pumping costs), which is vital for maintaining the competitiveness of the irrigated agriculture sector on the global market. Because the total amount of water is limited and all uses need to be ensured, the environmental perspective focuses on the water balance (i.e. withdrawals versus water used). From this point of view water saving is important and takes the form of reduction of losses and reduction of consumption/use.
- Irrigation water pricing is subject of major debate. There are substantial regional differences on water pricing systems. In general, the perception of respondents is that the current irrigation water price is barely sustainable for both farmers and consortia. Some respondents support the idea that water price should be differentiated according to uses and specifically that irrigation water should have a lower price than water used for other purposes. Extreme positions also emerged on this matter, being some respondent convinced that current water price is too low and some others that it is too high.

5 Improving irrigation water efficiency: a SWOT matrix

The findings presented above leads to a number of observations on the strengths and weaknesses of the irrigation water governance system in the study area as well as opportunities and threats to improve irrigation water efficiency. The SWOT matrix below summarizes these observations and the following paragraphs discuss them.

5.1 Strengths

A major strength of the irrigation water governance system currently in place in the CER district is the existence of consolidated networks grounded in relations of cooperation and trust among public and private stakeholders involved in irrigation water governance in the district. The CER consortium is a crucial node in most of these networks linking national, regional and local policy-makers to farmers and their representatives. The CER consortium has gained this position thanks to its capacity to raise resources and develop expertise to generate, apply and transfer knowledge on irrigation water efficiency over the decades. The ability to build and maintain quality standards has granted the consortium credibility and trust of other actors. The most notable example showing the CER consortium policy entrepreneurship and capacity building is the reputation reached by the IRRINET system. On the one hand, consortia and farmers increasingly adopt it; on the other hand the system gained the attention of policy-makers becoming adopted at national level. Furthermore, next to be practically useful the system has also an educational function as it has improved users' awareness of real water need of crops in the field.

Accountability and transparency emanating from a clear allocation of roles and responsibilities for irrigation water management is an additional factor strengthening relations of cooperation and trust. Furthermore, the capacity to renovate organizations, rules and regulations is a major strength providing ability to adjust to changing circumstances. For example, as the industrial and domestic uses of the CER water increase, the representation of users in the consortium boards needs to be adjusted to maintain a balanced representation of interests. The fact that this has been done once already shows awareness of the issue and willingness to address it.

5.2 Weaknesses

The fragmented allocation of responsibilities on water governance coupled to insufficient regional and inter-regional coordination negatively affects irrigation water efficiency. Decision-making in this crowded arena of actors is slowed down by the absence of coordinating institutions and becomes particularly problematic in situation of water scarcity. The lack of coordinating body with clear attribution of decision making power make it also difficult to handle conflicts over water uses (e.g. between agriculture and environmental uses). Furthermore, the excess of bureaucracy emanating from this system is a major barrier to the construction of water saving infrastructure such as small and large scale water reservoirs.

Another weakness of the current irrigation water governance system is the limited capacity to invest in new infrastructure at the local level. On the one hand, the contribution system based on irrigated surface is to blame as it does not allow to fully recovering water costs. On this point it is reasonable to think that as long as the

agriculture sector has major representation on the consortium boards adjusting irrigation water price (where needed) will be difficult. On the other hand, capacity of long-term strategic infrastructural and financial planning is lacking.

Finally, on a different ground, mechanisms allocating financial incentives to farmers (such as CAP resources) do not always efficiently support irrigation water saving. For instance, the CAP conditionality policy is such that incentives are not differentiated according to specific objectives, rather they are spread over all applicants under the conditions that they implement water saving measure. This approach leaves farmers who choose to make substantial investments in efficient irrigation systems with little financial support.

5.3 Opportunities

A major opportunity to enhance irrigation water efficiency is offered by the forthcoming revision of the water contribution system by land reclamation consortia (so called “piani di classifica”). The consortia have now the possibility to adjust the water contribution and when context situation allows (i.e. there is water infrastructure and possibility to install water meter) to establish a payment system based on water consumption. There would arguably be two positive effects associated with this: on the one hand, farmers would be stimulated to save water when they had to pay by amount used; on the other hand, consortia would have more resources to invest in infrastructural works. However, the risk is that of major opposition of farmers’ representatives in the consortium boards.

Another interesting contextual dynamics is that in 10 years a generation of farmers will retire. Depending on what will happen with the land becoming available this may be an opportunity. It is an opportunity if young farmers take over. Young farmers are interested in improving farm efficiency to increase their income, including irrigation efficiency. They are also more aware of existing technological opportunities and more inclined to rely on computer-mediated support such as IRRINET. However, it is not clear whether there is a young generation of farmers willing to invest in starting up a farm business. It is possible that much of this newly available land will be rented to existing farmers. This would threaten irrigation efficiency as tenants are reluctant to make substantial investment in efficient irrigation technology such as micro-irrigation on rented land.

Finally, another opportunity can be the new European Common Agricultural Policy (CAP). According to the known current working documents, irrigation efficiency will be a priority of the new CAP policy. If the current limitations of the conditionality policy will be addressed and resource will be more objective-oriented major improvement of irrigation water efficiency could be achieved.

5.4 Threats

The sustainability of agriculture depends on the possibility to ensure farmers a living income. If this is continuously at risk because of instability in food prices, the trend of old farmers retiring and not being substituted with young generations will worsen. Another consequence of food price instability and little marginal income is that farmers increasingly shift to high revenue crops which are often extremely water demanding (e.g. kiwi plantations in some areas of Emilia-Romagna) with the effect of a larger use of water.

A major dilemma threatening irrigation water saving comes from the European Agricultural Policy (CAP). Under the umbrella of its biofuels agenda, the European Commission has started subsidizing water demanding crops. Point in case is the production of maize for biofuels in Emilia-Romagna this year. Due to a severe drought coupled with extremely high temperatures the production was particularly low even if the fields were irrigated five times instead of the usual three. Considering that due to climate change such climatic conditions are expected to be more frequent, the dilemma whether to invest in green energy or in saving water is far from been resolved.

Finally, the prolonged economic crisis that has invested all developed countries has led to substantial financial cut to budgets for research and irrigation water saving measures. The trend is not expected to slow down in the coming years, thus making it difficult for the regional government to support water saving policies.

Table 5.1 SWOT matrix for irrigation water efficiency in the CER district

STRENGTH (reasons supporting irrigation water efficiency) • Clear allocation of roles and responsibilities on irrigation water management • Capacity to generate, apply and transfer knowledge for irrigation water efficiency • Presence of social capital: networks, cooperation, relations of trust, linking organizations • Capacity to renovate organizations, rules and regulation	**WEAKNESS** (reasons hindering irrigation water efficiency) • Fragmented allocation of responsibilities on water governance coupled with lack of regional and inter-regional coordination • Limited capacity at the local level to invest in new infrastructure • Not fully efficient allocation of financial resource • Excessive bureaucracy • Large representation of farmers' interests in the consortium boards prevents adjusting water price to increased costs
OPPORTUNITY (reasons that could favour irrigation water efficiency) • Revision of land reclamation consortia water contribution system (so called "piani di classifica") • Major farm structural change due a generation of farmer retiring in about 10 years • European CAP post 2013 which is more oriented to supporting irrigation efficiency • Increasing water scarcity may lead to improve irrigation efficiency	**THREAT** (reasons that could hinder irrigation water efficiency) • Instability of global food price • Low marginal income for farmers leading to abandonment of agriculture • European CAP policy subsidizing water demanding crops (e.g. maize for biofuels) • Economic crisis leading to less financial resources for research and irrigation water saving incentives • Major farm structural change due to farmer generation change in about 10 years

6 Improving irrigation water efficiency: institutional dynamics and policy recommendations

The existence of new actors, discourses and rules revolving around a policy domain is fundamental trigger of change (Huitema and Meijerink 2009). The interviews with key informants have revealed the existence of a consolidated network of actors, relations of collaboration and trust in the irrigation sector as well as capacity of public organization to change rules (e.g. the reform of the land reclamation consortia). The analysis also suggests the existence of institutional dynamics (such as the raise of new actors, discourses and rules) that may constitute entry point for taking additional actions to improve irrigation efficiency.

The lack of water which was the main driver of actions in the past could induce additional actions to improve irrigation efficiency in the future. All public and private actors interviewed agree that the regional agriculture sector cannot sustain an intense drought nearly every other year as it has happened since early 2000s. In the 1950s the government's vision of developing agriculture as source of regional income led to the construction of the CER canal. Nowadays the need to pursuit more irrigation efficiency finds its reasons in the evidence that the agriculture sector in Emilia Romagna is a vital regional and national economic resource, and that the climate change problem needs to be taken seriously. All interviewees agree on the importance of constructing a wide network of small scale reservoirs as well as some major ones to reduce the risk of water crisis. At present, however, the major obstacle to the construction of water infrastructure is the excessive bureaucracy and insufficient resources to carry out these works.

In the CER district domestic and industrial users of the CER water (e.g. drinking water companies) are coming into the picture asking for more decision power in water allocation and pricing. These actors are entering water policy circles through the board of the land reclamation consortia. Now still playing a minor role, their influence may become more relevant as the diversification of uses of the CER water increases. A discourse that is gradually gaining consensus and is connected to the raising of these new actors is that the composition of the board of the land reclamation consortia will have to reflect the increasing diversification of uses of the CER water by giving greater representation to these new users. This implies that representatives of the agriculture sector will play a less relevant role in determining irrigation water pricing and allocation in the future. These new actors have their own agenda for the allocation of the CER water and water pricing. A consequence of that could be an increase in the price of irrigation water and a decrease of the amount of water available for irrigation. This in turn may force farmers to become more efficient. Indeed, the fact that the rules for electing the board of the land reclamation consortia have already been changed towards greater representation of other sectors and that the consortia have now to reform their water pricing regulations could already lead to adjustments of irrigation water price in some consortia. However, at present these changes will probably be small, as an interviewee has pointed out, because the agricultural sector is still dominant in the consortia board. Nevertheless, these new rules have potential to indicate the way forward by establishing principles of equitable water pricing such as the internalization of environmental costs and benefit.

Other actors that are at the door and may play a key role in the future are young farmers. In about ten years a generational change will occur in the farming system of the region with young farmers possibly entering into the agricultural system. Young

farmers are entrepreneurs who want to reduce production costs and have the resources to understand how to achieve this goal as they usually have higher education and better familiarity with new technologies than the old generation. Therefore, if they will take over, they may become important driver of irrigation water efficiency.

Finally, important public actors that will soon enter the policy making arena are water district authorities. It is difficult to predict the impact of this major change. District authorities are expected to improve efficiency of water allocation and uses as they plan the water resource at catchment level. However, water districts in Italy are extremely big and interviewees think this may become a source of inaction because they would easily be detached from the local communities and their problems.

6.1 Policy recommendations

In light of the analysis conducted in this report a number of policy recommendations can be drawn.

- About efficiency in water distribution:
  - Developing long-term water infrastructural work plans would help the land reclamation consortia to have an overview of the order of magnitude of the required budget which in turn would help planning it.
  - Setting aside at least part of the water contribution paid by the land reclamation consortia (that now goes in the general regional budget) to finance water infrastructural works would help improving the irrigation canal networks of the consortia.
- About efficiency in the farm:
  - Adjusting the current incentive system so that farmers who have shown willingness to use water more efficiently have adequate support would make the use of resources more effective and would possibly encourage other farmers to become more efficient as they see it pays off in terms of both saving money and obtaining incentives.
  - Strengthening and making training programs and information campaigns for farmers more specific on for example the use of micro-irrigation and other water saving technologies would help increasing farmers' awareness on irrigation water efficiency. For instance, inviting farmers who had already experienced the advantages of using a specific technology to share their experience during training sessions would be more effective than only having experts teaching the course as farmers would be more inclined to trust fellows with firsthand experience. On the same line of reasoning, visiting demonstration fields next to indoor training sessions could lead to more effective training. Therefore, financially supporting the wide spread of demonstration fields would be beneficial.
- About water pricing:
  - Paying water on the basis of the quantity used is one of the most commonly water saving measures suggested in the literature. However this is conditioned to the possibility to quantify the amount of water used in the field through the installation of meters. This is not possible everywhere as it depends on the water infrastructure available. Nevertheless, this is the target to be pursuit by the land reclamation consortia.

- Differentiating the water contribution in categories of use (who use more water has to pay more) would probably have an additional positive effect in terms of water efficiency.
- Having a more equitable distribution of water costs on different uses would make all users more inclined to accept the cost to pay. This implies including in the calculation of costs also environmental benefits (for which everybody has to pay) and losses (for which the responsible users have to pay).

- About organizations and rules:
  - A permanent coordinating body in charge of solving problems of water scarcity would help overcome the problem of fragmented responsibility which often leads to conflicts in times of water crisis.
  - Organizing the new land reclamation consortia into territorial sub-units with local offices as reference point for members to ask questions or do paper work would help land reclamation consortia being more responsive to the needs of the community including that of farmers.
  - Balanced representation of all users into the land reclamation consortia board would help better planning and distribution of water.
  - Higher inter-regional coordination on water management would better serve the interests of the country in international water political and policy arenas.
  - Simplifying water management bureaucracy would benefit farmers, public organizations and in general would serve the purpose of increasing water efficiency.

7 Conclusions

The objective of this report was to assess the current water governance system in place in the Canale Emiliano Romagnolo District in the Emilia Romagna region, Italy and identify context relevant approaches for promoting a more efficient use of irrigation water in this context. To this end, an analysis of actors, rules, resources and discourses was conducted following the Policy Arrangement Approach (Arts *et al*. 2006). Archive data (legal and policy documents, and assessment and thematic reports) and interviews (10 informants were interviewed in September 2012) were used for this study.

Findings suggest that major differences exist with regard to irrigation water efficiency at regional level. A closer look to the CER irrigation district reveals that in this territory irrigation water efficiency has been increasing over the years although there is room for further improvements. The main reason for this performance is the need to overcome water shortage. Under this pressure, especially affecting the Romagna part of the region, an artificial irrigation water canal, the CER canal, was constructed in the second half of the twentieth century. This large infrastructure triggered a number of further actions including the construction of a network of canals and related infrastructure for water distribution and research on how to efficiently use the canal water. These actions favoured the development of connections, relations of trust and cooperation among stakeholders. Over 50 years later the outcome of this process is today's high level of social capital, knowledge and expertise in the irrigation water domain which is the major strengths of the existing irrigation water governance system. The CER consortium is a crucial organization in this system linking national, regional and local policy-makers to farmers and their representatives and with capacity to connect to international organizations as well. The CER consortium has gained this position thanks to its capacity to raise resources and develop expertise to generate, apply and transfer knowledge on irrigation water efficiency.

Much can still be done both at the farm level and at the water network level to improve irrigation water efficiency in the CER district. At the farm level, more training on how to properly use irrigation technology and information on the importance of using water efficiently is needed as the main driver for switching to more efficient technology is still economic. About the water distribution network, the main problem is lack of long-term investment planning and difficulty to generate sufficient resources. Finally, the fact that irrigation water management is nested in a fragmented water governance system is a major limitation to further improving irrigation water efficiency. Although, reforming the water governance system is responsibility of the national government, greater coordination of regions would help guiding this reform.

To conclude, although there is still room for improvement the existing irrigation water governance system in the CER district could be taken as example of a governance system where there is capacity to improve irrigation water efficiency and to adjust to changing circumstances. This conclusion has to be taken with the understanding that building factors of success such as social capital, credibility and trust takes long time, requires investment of financial resources and is facilitated by the presence of so called policy entrepreneurs, i.e. actors (often bureaucrats) who seek to change policy by acting at the boundary between different interests throughout the policy-change process.

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Annex A Questionnaire in English and Italian

A.1 Questionnaire in English

Background information of the interviewee

1. What is the role of your organization in water management in general and irrigation water management specifically?
2. What is your position within the organization?

Current irrigation water governance structure

Actors and coalitions

3. How is the irrigation water management system organized in general and in your district specifically (i.e. who is responsible for what and at which organizational level)?
4. Are private organizations (e.g. farmers associations, environmental NGOs) involved in irrigation water management? If, yes, who are they and what is their formal and informal role?
5. Do *public* organizations cooperate for irrigation water management? If yes, which forms of cooperation are in place (agreements, cooperation established by law, etc)?
6. Do *public and private* organizations cooperate for irrigation water management? If yes, which forms of cooperation are in place (agreements, partnerships, etc)?

Resources

7. In your opinion, are irrigation water management responsibilities clearly defined and allocated?
8. Are irrigation water management responsibilities overlapping (i.e. different organizations in charge of the same task)? If yes, how are common responsibilities dealt with (i.e. is there a cooperative attitude or are there conflicts and claims for authority)?
9. In your opinion, which stakeholder(s) have major responsibility and/or influence in the irrigation water management system and why? How is their influence exercised?
10. In your opinion, is knowledge and expertise on irrigation water management and water saving technologies sufficiently developed? If not, what do you think is the problem and why (e.g. lack of financial resources, lack of experts/expertise, lack of interest, difficulty to access and transfer new knowledge, lack of extension infrastructure)? Focus the question to the target technology to be adopted in the specific case study area.
11. In your opinion, is knowledge and expertise on irrigation water management and water saving technologies progressing? If not, what do you think is the problem and why (e.g. lack of support to innovation, lack of sufficient integration of new technology in farming practices, lack of public-private partnerships linking farmers to private industry developing the new technologies)? Focus the question to the target technology to be adopted in the specific case study area.

Rules of the game

12. Which formal institutions (i.e. laws, regulations, policies and procedures) are important for irrigation water management?
13. Which informal institutions (i.e. rules that are created, communicated, and enforced outside of officially sanctioned channels) such as standard practice,

cultural rules, local habits of dealing with each other and with irrigation water exist and have an influence on irrigation water management? Examples include water use rights that have been passed on for generations but never formally granted by law, or water trade practice among farmers that is not regulated be law, and alike.

14. Have any irrigation water saving policies been adopted to improve irrigation water efficiency and increase water saving? If yes, can you list and describe them?

Discourses

15. Is there a water shortage in your region or not?
16. Is water wasted or used efficiently at the moment?
17. Who are the bigger users, and how efficient are they in your opinion?
18. Do you think that the price that water users pay is right or not?
19. Is water efficiency an important issue in your organization?
20. Does your organization see the need to be more efficient?
21. Does your organization consider greater efficiency technologically feasible?
22. What is your personal take on sustainable and efficient irrigation water management?
23. Can you identify the main argument(s) supporting the current (irrigation) water policies and those supporting the reform of these policies?

Prospects for improving irrigation water governance

24. What is your personal opinion of the current (irrigation) water policy system?
25. What do you think are the current major incentives and disincentives to irrigation water efficiency, if any?
26. What do you think should be changed in the current water management system, if anything?
27. How do you think current water policies could be improved?
28. Consider these two categories of policy instruments: lenient such as government communications, voluntary agreements, and subsidies, and stringent such as water right regulations, and water taxations. Which typology do you think has more chances to be adopted and efficiently implemented in your region? Why? By whom and how?

A.1.1 Questionnaire in Italian

Informazioni relative all'intervistato

1. Qual'e' il ruolo della sua organizzazione nella gestione dell'acqua in generale, e in particolare nella gestione dell'acqua a uso irriguo?
2. Qual'e' la sua posizione all'interno dell'organizzazione?

Stato dell'arte della gestione delle risorse idriche a uso irriguo

Attori

3. Com'è organizzata la gestione dell'acqua a uso irriguo in generale e nel suo distretto nello specifico (ovvero chi è responsabile per cosa e a che livello organizzativo)?
4. Vi sono organizzazioni private (oltre ai consorzi di bonifica, qui si intendono per esempio imprese che producono tecnologia per l'irrigazione, oppure organizzazioni non governative come associazioni ambientaliste o di agricoltori) coinvolte nella gestione dell'acqua a uso irriguo? Se sì, quali sono e qual è il loro ruolo formale (stabilito da norme/regolamenti) e il loro ruolo informale (non definito da norme/regolamenti)?

5. Esistono forme di collaborazione tra le organizzazioni pubbliche (inclusi i consorzi di bonifica) per la gestione dell'acqua a uso irriguo? Se sì che tipo di forme di collaborazione sono attuate (es. accordi di programma o altre forme di accordi stabilite per legge)?
6. Esistono forme di collaborazione tra organizzazioni private (come intese alla domanda No. 2) e pubbliche per la gestione dell'acqua a uso irriguo? Se sì che tipo di forme di collaborazione sono attuate (es. partenariati, ecc.)?

Risorse

7. Secondo lei, le competenze per la gestione dell'acqua a uso irriguo sono chiaramente definite e distribuite?
8. Esiste sovrapposizione di competenze tra diversi soggetti per la gestione dell'acqua a uso irriguo? Se sì, come sono gestite le competenze condivise, ovvero secondo lei c'e' un approccio in generale di tipo collaborativo o esistono conflitti e competizione per l'attribuzione di competenze?
9. Secondo lei, quali sono i soggetti che hanno maggiore responsabilità e/o influenza nella gestione dell'acqua a uso irriguo e perché? Com'è esercitata l'influenza di questi soggetti?
10. Secondo lei, la conoscenza scientifica e le competenze tecniche per la gestione dell'acqua a uso irriguo e le conoscenze relative alle tecnologie di risparmio irriguo sono adeguatamente sviluppate? Se no, quale pensa sia il problema/i e perché? Ad esempio, è un problema di mancanza di risorse finanziarie, mancanza di esperti e/o di competenze tecniche specifiche, mancanza di interesse per il risparmio irriguo, difficoltà di accesso alla conoscenza scientifica e/o di trasferimento di tale conoscenza, mancanza di infrastrutture di supporto adeguate?
11. Secondo lei, la conoscenza scientifica e le competenze tecniche per la gestione dell'acqua a uso irriguo e le conoscenze relative alle tecnologie di risparmio irriguo nel suo territorio stanno progredendo/migliorando? Se no, quale pensa sia il problema/i e perché? Ad esempio, mancanza di supporto all'innovazione, mancanza di sufficiente integrazione delle nuove tecnologie nelle pratiche agricole, mancanza di collaborazione/partenariato tra soggetti pubblici e privati capaci di collegare gli agricoltori alle imprese che producono nuove technologie.

Norme, pratiche e prassi per le decisioni

12. Quali norme, regolamenti, legislazioni, politiche e procedure (istituzioni formali) sono rilevanti per la gestione dell'acqua a uso irriguo?
13. Quali pratiche, procedure, prassi, usi e costumi relativi alla gestione dell'acqua a uso irriguo esistono e influenzano la gestione dell'acqua in agricoltura (qui si intendono le istituzioni informali, ovvero norme create, comunicate, e attuate al di fuori delle regolamentazioni formali)? Esempi di questo tipo includono diritti d'uso dell'acqua tramandati di generazione in generazione senza essere formalmente riconosciuti, accordi informali tra agricoltori per l'utilizzo dell'acqua, ecc.
14. Sono state adottate politiche e/o misure per il risparmio dell'acqua irrigua e per il miglioramento dell'efficienza dell'uso di acqua irrigua? Se sì, che tipo di misure/politiche sono (tassazione, sussidi, accordi, regolamentazioni)? Può elencarle e descriverle?

I temi che ruotano attorno all'acqua per uso irriguo

15. C'è carenza di acqua nel suo distretto/territorio?
16. Ad oggi secondo lei, l'acqua viene utilizzata in modo efficiente oppure viene sprecata?

17. Secondo lei chi sono i maggiori utilizzatori di acqua e quanto sono efficienti nell'uso della stessa?
18. Ritiene che il prezzo dell'acqua pagato dagli utilizzatori sia equo e che rifletta adeguatamente le effettive disponibilità idriche del territorio?
19. L'efficienza di uso dell'acqua è un tema di rilievo e interesse per la sua organizzazione?
20. La sua organizzazione ritiene sia necessaria una maggiore efficienza nell'uso dell'acqua (quando pertinente si intende efficienza d'uso da parte dell'organizzazione)?
21. La sua organizzazione ritiene che sia tecnologicamente fattibile una maggiore efficienza d'uso dell'acqua?
22. Qual è la sua opinione personale relativamente alla gestione efficiente e sostenibile dell'uso dell'acqua a scopo irriguo?
23. Può identificare i principali argomenti a supporto dell'esistete sistema e politiche di gestione dell'acqua a uso irriguo e gli argomenti invece a supporto della necessità di riformare il sistema esistente?

Opportunità e prospettive di miglioramento del governo dell'acqua a uso irriguo

24. Qual è la sua opinione personale sull'attuale sistema di governo e gestione dell'acqua ad uso irriguo?
25. Quali ritiene siano i principali incentivi e disincentivi per una gestione efficiente dell'acqua ad uso irriguo, se ce ne sono?
26. Cosa ritiene dovrebbe essere cambiato nell'attuale sistema di governo e gestione dell'acqua ad uso irriguo (se c'è qualcosa)?
27. Come ritiene che le attuali politiche di gestione dell'acqua potrebbero essere migliorate?
28. Consideri le seguenti due categorie di strumenti per le politiche di gestione dell'acqua: strumenti "soft" come informative delle amministrazioni pubbliche, accordi volontari, sussidi; e strumenti "stringenti" come regolamentazione dei diritti d'uso dell'acqua e tassazione dell'uso dell'acqua. Quale delle due tipologie ritiene abbia maggiori probabilità di essere adottata e attuata con successo nel suo distretto/territorio? Perchè? Da parte di chi e come?

Annex B List of interviewees

Name	Organization	Position in the organization
-	*Regional department for environment* Assessorato Ambiente Regione Emilia Romagna – Servizio Tutela e Risanamento Risorsa Acqua	Public officer at the water protection division
Giapponesi Andrea	*Regional department for agriculture* Assessorato Agricoltura Regione Emilia-Romagna - Servizio ricerca, innovazione e promozione del sistema agroalimentare	Public officer at the research, innovation and agriculture promotion division
1) Dal Monte Andrea 2) Pederzoli Antonio	*Farm* CAB Massari - Cooperativa Agricola Braccianti Massari	1) Vice-director 2) Technician
Peri Piero	*Farmer labour union* CIA- Confederazione Italiana Agricoltori Emilia-Romagna	Chief of the environment division
Ghetti Alessandro	*Farmer labour union* Coldiretti Emila-Romagna	Chief of the legislative division; in charge of land reclamation and water
1) Giglioli MariaTeresa 2) Vecchi Monica	*Land reclamation consortium* Consorzio di Bonifica dell'Emilia Centrale	1) Chief of information and communication division 2) Officer of hydraulic network division
1) Fabbri Alessandro 2) Prometti Laura 3) Turci Marco	*Land reclamation consortium* Consorzio di Bonifica della Romagna	1) Chief at agrarian technical division - planning and execution of infrastructural works 2) Officer at environment and spatial planning division 3) Officer at territorial and irrigation management division
Piva Alessandro	*Producer organization* CIO – Consorzio Interregionale Ortofrutticoli	Chief of the technical-agronomic division
Reggidori Giampiero	*Producer organization* APO CONERPO – Organizzazione Produttori Ortofrutticoli - Centro Ricerche Produzioni Vegetali dell'Emilia-Romagna	President
Mannini Paolo	*CER land reclamation consortium* Consorzio di Bonifica di Secondo Grado per il Canale Emiliano-Romagnolo	Director of agronomic-environment division